Conversations with Medical Informatics Pioneers:

An Oral History Collection

Founder of the HELP System and the Utah Medical Informatics Program

2005 Interview of Homer R. Warner, Sr.

Interviewer:

Dean F. Sittig

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Q&A

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Oral History Interview with Homer Warner, Sr.

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2005 Interview of Homer R. Warner, Sr.

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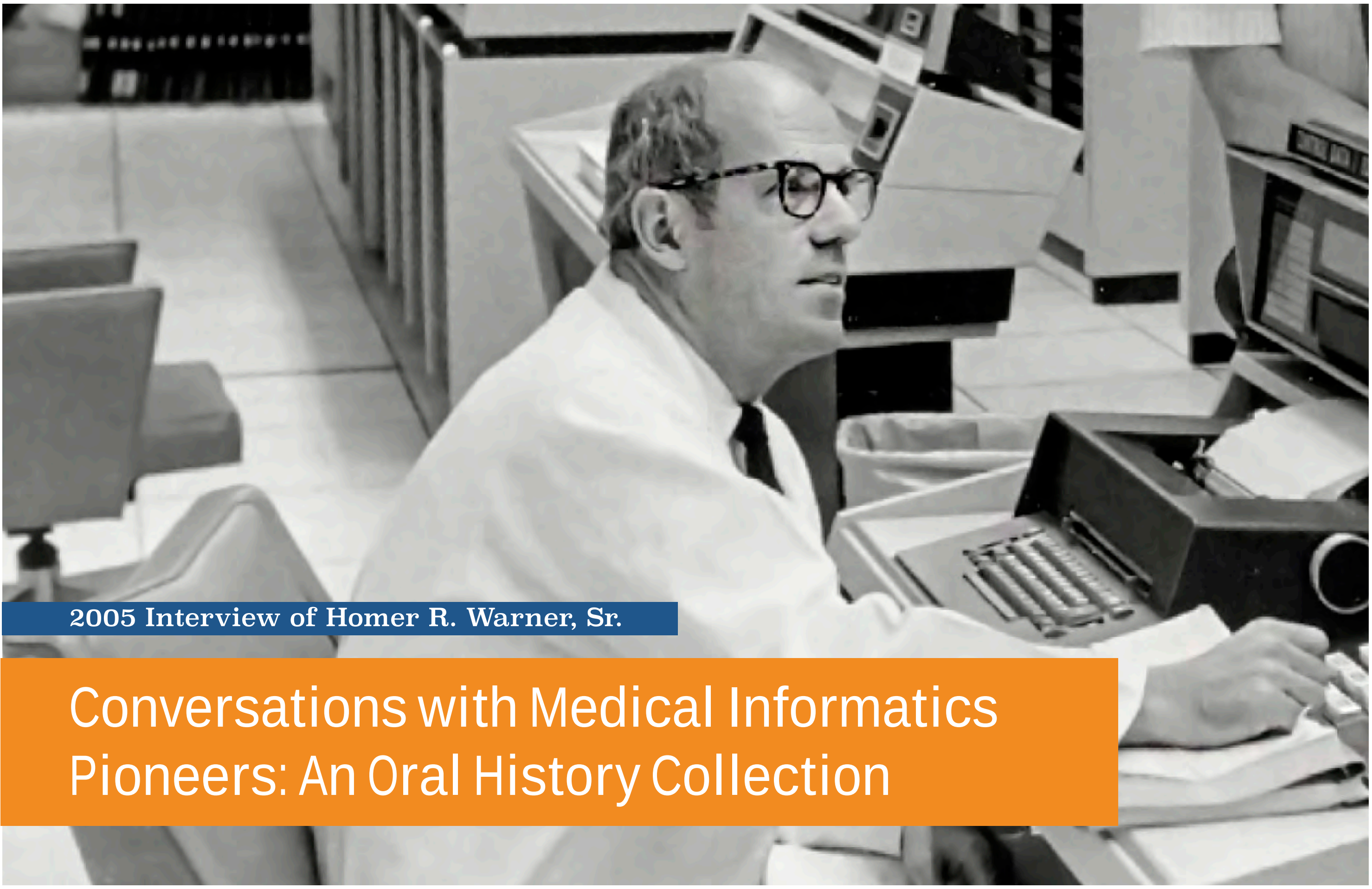


Courtesy of Intermountain Healthcare.

Homer Warner in the computer room at Intermountain Health. HELP was expanded throughout much of LDS Hospital over the following two decades, after its launch in 1967. While decision support remained the focus, automation benefits were realized as a byproduct, and a robust database was developed.

Founder of the HELP System and the Utah Medical Informatics Program

Homer R. Warner, MD, PhD, was a cardiologist who pioneered many aspects of using computers to augment the practice of medicine, including clinical decision support tools

INTERVIEWED BY
DEAN SITTIG
MAY 16, 2005
SALT LAKE CITY, UTAH

Homer R. Warner was born in 1922 at the Latter Day Saints (LDS) Hospital in Salt Lake City, Utah and went on to create that hospital's first cardiovascular diagnostic laboratory in 1954. In 1964, Dr. Warner originally founded and became the first Chair of the Biophysics and Bioengineering department in the College of Engineering, which was renamed and relocated to the School of Medicine in 1972. In 1985, it became the first "medical informatics" department in the United States.[1] In 2006, the department was renamed Biomedical Informatics. Dr. Warner and his colleagues developed the HELP (Health Education through Logical Processing) system, which is still in use today at Intermountain Healthcare.[2-7] He wrote numerous landmark papers and books in the field of medical informatics.[8,9] Dr. Warner received his bachelor's and medical degrees from the University of Utah and a doctorate degree in physiology from the University of Minnesota. In 1994, he was the second recipient of the Morris F. Collen Award of

Excellence.[10,11] The Homer R. Warner award, named in his honor, is presented each year at the AMIA Fall Symposium for the paper that best describes approaches to improving computerized information acquisition, knowledge data acquisition and management, and experimental results documenting the value of these approaches. Dr. Warner's legacy of excellence and innovation has persisted, and the Department remains a leader in informatics research, training, and implementation.[12,13] To illustrate his contribution to informatics applied to medicine, on the patent called "Rules-based patient care system for use in healthcare locations" issued on January 1, 2008, the references list includes seven works on which he collaborated.[14] Dr. Warner died, at age 90, on November 30, 2012, after a brief illness.[15–19]

Homer R. Warner, a pilot in the VF "Grey" Squadron 199, in his flight suit, 1945.

DS ***It is Monday, May 16, 2005, and this is Dean Sittig. I'm here with Homer R. Warner, Sr., in Salt Lake City, at his house. I guess I have to say "Senior," because your son is also in this field, and a lot of the people working now probably know your son better than you.***

HW Probably.

DS ***So I'll put the tape recorder up here, and then we'll start asking some questions. What I'd like to start with is this: Could you just tell us a little bit about where you were born and where you grew up and went to school, and then how you became interested in this field?***

HW Well, we're fairly close to where I was born.

DS ***Is that right?***

HW Yeah. I was born in Salt Lake at the LDS Hospital, as a matter of fact. On my mother's side, I came from a family of doctors. In fact, my grandfather was one of the founders of the Salt Lake Clinic. I think Mother always pictured me as coming home and setting up practice in the Salt Lake Clinic. I guess she was a little disappointed when I went into research. That was sort of the plan, you know. I went all through my schooling here in Salt Lake City, including medical school. Before I went to medical school, I was in the Navy Air Corps for a couple of years, and flew one of those airplanes.

On my mother's side, I came from a family of doctors.

DS ***Which kind is that?***

HW It was a Grumman F4F-4, and I was a Navy carrier-based fighter pilot.

DS ***Oh, my goodness. Was that in the Second World War?***

HW Yes. So I came home and went to medical school, and our class was the first class after the war, and we had a bunch of old men in there. We got through in three years or so, on an accelerated schedule. I became interested in physiology, particularly. I had a particularly

Earl H. Wood, 1950.

wonderful professor, Horace W. Davenport, who inspired me to take an interest in that area.

After medical school, I went to Dallas and interned under Tinsley [Timothy] R. Harrison, who later became Editor-in-Chief of Harrison's Principles of Internal Medicine—for the first seven editions. He was going to leave there that year and go to Alabama, so he sent me up to the University of Minnesota, where I did my residency in internal medicine and then moved, for part of that training, down to the Mayo Clinic. It was down there that I got interested in research. That would have been in about 1951, right at the height of the initial entrance into cardiovascular surgery, you know. They were doing the first heart-lung bypass surgery. Earl H. Wood, whom I worked with, was doing a lot of the original work on diagnostic methods, with indicator-dilution curves and so on, to diagnose congenital heart disease. It was just a very stimulating environment. I knew because I attended research seminars during the summer that year, while I was on one of the services. I went to these seminars where they reported every week on the progress of their research. I decided then that I wanted to give research a try, and so I took a year out to do research, and never got back! [laughter] So my thesis was on the development of a method for estimating the stroke volume of the heart on a beat-by-beat basis from the shape of the pressure wave from the aorta. Dr. Wood liked it and thought I should make a PhD dissertation out of it, so I went back up to Minnesota for another year and finished the rest of the class work requirements and so on, and got my PhD. So, here I was with an MD and a PhD and no job, and I knew I wanted to come back to Salt Lake City. I was able to apply for an American Heart Fellowship, and I got that, a one-year appointment.

I did my residency in internal medicine and then moved, for part of that training, down to the Mayo Clinic. They were doing **the first heart-lung** bypass surgery.

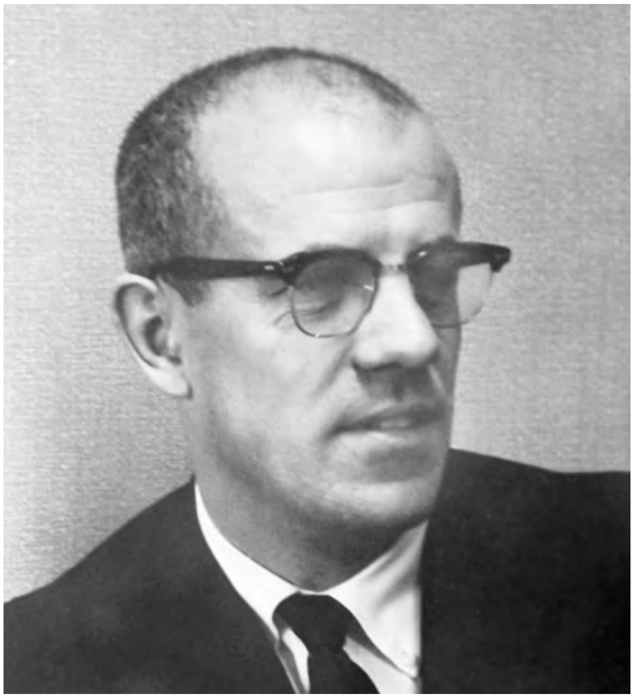
I came back here to the University of Utah, which was housed, for the clinical years, in the old County Hospital [at 2100 South State Street]. I worked under a man named Hans Hecht. Dr. Hecht was a very bright man, very enthusiastic. I enjoyed that very much. He was hard to understand—he had a thick German accent—but he was very good. During that year, I had a visit from the Administrator of the LDS Hospital, and Dr. W. Ray Rumel, who was the only heart surgeon in town, asked me if I would come to LDS and set up a diagnostic cardiovascular laboratory so they could do heart surgery. And so I did. The next year, we went up there and built this laboratory patterned after the approach that Dr. Wood had had at the Mayo Clinic. We did diagnostic studies, primarily on congenital heart disease in those days, because there was a big backlog of patients. There'd been no treatment for them, you see, until just then. So it was an exciting time.

I spent one night analyzing a single heartbeat into its harmonic components.

But I had an interest in research, and knew this was what I really

Homer R. Warner, 1951.

wanted to do. I took a class while I was doing this work with diagnostic cardiology, at the University, in what they called advanced engineering math. It really wasn't advanced at all. For me, it was very advanced, but it was differential equations. The teacher was a man named C. R. Wiley, who wrote the textbook Advanced Engineering Math in 1951. He was excellent. He just had all kinds of interesting illustrations of the principles he was teaching. One day, he talked about Fourier analysis. I was very interested in that, because of dealing with arterial pressure waveforms. So I went home, and I bought a three-foot-long slide rule with trigonometric functions on it. I spent one night analyzing a single heartbeat into its harmonic components, and convinced myself that I understood how to do that. A few days later, he talked about another technique, which he called a "transfer function," which was able to use signals representing both the input and the output signals from a system, and said that you could mathematically characterize such a system. So I thought, "I'll try that." I'll do it on the same heartbeat on the upstream and downstream pressure wave, because during my thesis work, I knew that the pressure wave got distorted as it traveled down the artery, but I didn't know how to explain it or take care of it. I was always interested in it. So we did that, and we found that the system—the arterial bed—was acting like a resonant system; it had certain frequencies that were being amplified and other frequencies that were being damped out. The resonant feature caused the peripheral pressure waveform to be more "peaked." He told us that those kinds of systems could be represented by electrical circuits. So I decided to build an electrical circuit that would be an analog of this arterial bed. That got us started on what turned out to be the analog computer. We found out that we could indeed, by using a second-order differential equation, build a system that could distort the pressure waveform exactly the way the arterial bed distorted the pressure waveform.



Homer R. Warner, ca. 1960s.

By Permission of the Mayo Historical Unit, Mayo Clinic, Rochester, Minnesota. Permission is granted for one-time use only.

I remember we put a patient on the table for diagnostic studies, and had a catheter in the aorta. Then we put a needle in the radial artery for other reasons, and while my helper watched the patient, I'd run upstairs, and we'd feed the upstream pressure [aortic] waveform into the circuit. Then we'd look at the output of the circuit on one beam of a dual-beam oscilloscope, and on the other beam, the output at the other end of the artery [radial artery], and then tune the circuit until those two waveforms matched. At that point, then, we could read off the parameters that described the physical properties of that artery. Well, because of that research work, we got us our first research grant.[20,21]

So I decided to build an electrical circuit that would be an analog of this arterial bed. That got us started on what turned out to be the analog computer.

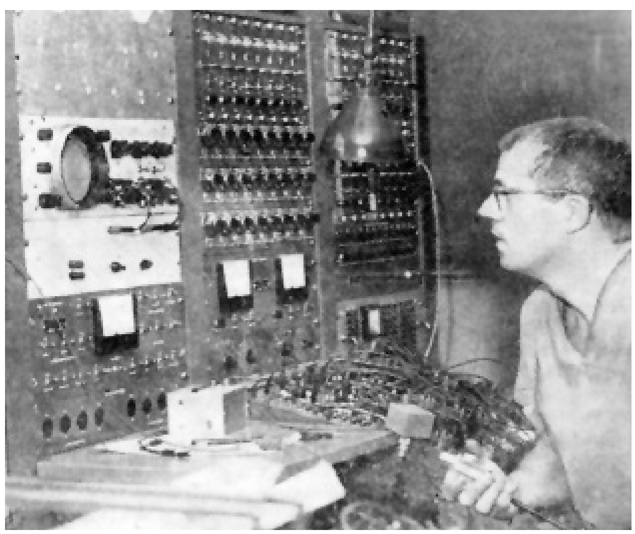
DS ***I'll bet!***

HW And we used that analog computer, I expect, for about 10 years. That would have been back about 1960. We did all kinds of studies, and our interest, of course, was primarily with the circulation, because that's where we had access to real data. So we were interested in how the cardiac output got regulated when you exercised. We knew that there was a baroreceptor in the carotid sinus, and so we began studies to try to see what the transfer function of that system was, where the input would be pressure and the output was the frequency of firing of the single nerve fiber going up to the brain. Burgess N. Christensen was my student doing that project. He later became Professor of Physiology at the University of Texas in Galveston. But we found that we could, indeed, describe that transfer function, and for the first time, we had a quantitative description of the transfer function. We found it was sensitive to the derivative, or the rate of change of pressure, as well as the pressure and that it was a nonlinear relationship, and, in addition, the transfer function "adapted" over time. Thus, the carotid sinus was a device not for long-term regulation of blood pressure, but for quick adjustments, like during the onset of exercise, or going from a sitting to a standing position. So, that was the beginning of it, and then we studied other components of that system.

The notion that peripheral resistance controlled the cardiac output; it was perhaps the most interesting thing I ever did.

We actually used the analog computer as the tool to control experimental animals. We'd have a flowmeter on the ascending aorta to measure the cardiac output. We'd place a catheter in the aorta to measure the pressure recording in a dog, and then we'd place a cloth cuff around the descending aorta just above the diaphragm. Between the cuff and the artery was a balloon connected to a tube coming out of the chest of the dog to a pneumatic device controlled by the computer. The first thing that happened was, we started the treadmill. There was a transient drop in blood pressure, and a big drop in resistance to flow, before there was any increase in cardiac output. So, our postulate was that the drop in resistance was responsible for the increase in cardiac output. If that were the case, if we could hold the resistance constant by using this little balloon-filled cuff on the descending aorta and keeping the resistance at the resting level, we could prove that regulation of cardiac output during exercise was accomplished through regulation of pressure in the arteries. Indeed, we should be able to prevent the rise in heart rate and cardiac output upon initiation of exercise. In fact, that turned out to be the case. So, we published those results.[22]

If I had to point to one thing that represents my contribution, I suspect that's the notion that peripheral resistance controlled the cardiac output; it was perhaps the most interesting thing I ever did.



Courtesy of Stan Huff, Intermountain Healthcare.

Homer Warner with the analog computer.

DS ***Yeah, I'll say!***

HW It was an exciting time. In the meantime, the digital computer came along. The University of Utah had acquired a digital computer in the Engineering School, and I had a student working with me—an intern, actually. We would go up to the computer and try running different kinds of programs. I wanted to learn how to use it. So we did, and we did a lot of studies trying to describe the distribution of transfer times around different components of the circulation with dye indicators. We found some very interesting things, both in terms of the effects of different kinds of activity and different kinds of drugs, and the shunting of blood from one organ system to another.[23]

And then one day, Robert Stephenson, a friend and faculty member in the Engineering School, pointed out an article by Robert S. Ledley* and Lee B. Lusted about using probabilities and logic to make medical diagnosis.[24] They had used Bayes' Theorem to assist with medical diagnosis.[25] We thought, well, that might be a good thing to try, because we've got a lot of patients coming through our laboratory with congenital heart disease. So we began collecting data by asking each of the doctors who referred us cases for catheterization to fill out a checklist of the patient's manifestations, and also to put down their own estimate of what they thought the patient had. And so we'd then send the patient through our diagnostic procedures. After the diagnostic procedure you'd know what the real diagnosis was. It was a nice thing to do, because we had data. We'd use that data, then, to create a matrix of symptoms and diseases and find sensitivities and specificities and so on. Once we created that, then we began to study new patients to see if we could actually predict a diagnosis on a given patient before the diagnostic procedure was done.[26] We published that in the Journal of the American Medical Association[27] — that was in 1961. But that was a breakthrough for us, because it drew some attention to the LDS Hospital laboratory. It was really, I think, largely as a result of the diagnostic study and some of the indicator-dilution studies we'd done with the computer that made us eligible for a Research Resource grant from NIH. And that's how we got our first digital computer at LDS Hospital. That was an exciting thing.[28,29]

We got a little IBM 1620 computer to begin with, and then within a couple of years, we upgraded to a Control Data Corporation [CDC] 3200 computer. The 3200 was a wonderful machine for its time, but there was no software for it. It didn't even have a FORTRAN compiler. We did everything in assembly language. We allowed each user only 2K of memory for their program. So the user had to write the program with its own overlay, so it would bring in more memory from disk. But with that, we accomplished some interesting things. We had students like Al Pryor, for instance, who did his PhD thesis developing computer-based ECG interpretation. We had Reed Gardner,* who developed methods for monitoring patients. He implemented the algorithm that I'd developed in my thesis for estimating stroke volume as the basis for monitoring—first in the operating room, and later in the ICU. Those were very exciting times.[30,31]

It was a wonderful time, because you really

We'd use that data, then, to create a matrix of symptoms and diseases and **find sensitivities and specificities** and so on. Once we created that, then we began to study new patients to see if we could actually predict a diagnosis on a given patient before the diagnostic procedure was done.

Courtesy of Intermountain Healthcare.

In April 1965, Reed Gardner and Homer Warner presented their findings about use of computers to simulate cardiac function at Fall Physiology Meetings in Atlantic City, NJ. In 2015, Reed recalls, "This photo was taken at a 25 cent photo booth! You should note that when Dean Sittig conducted this interview, Homer was 80 and what he remembered is right on, based on information I verified from archived papers from the librarians. That is remarkable to me, especially now that I am approaching that age."

didn't have to read the literature. Nobody could have accomplished what we did then, because there was no tool available. It's hard to imagine these days, that we could have been in that situation. I stayed awake a lot of nights trying to think of what to do with that machine, because we had all that computing power, and a few very capable people to work with it, but it was a real challenge.

Reed [Gardner] built computer terminals for us that used a memory oscilloscope, because we couldn't afford the machine cycles to regenerate the images on the screen. Then, he had a bank of lights in the ICU—three lights for each patient—a red, a yellow, and a green light. The green light would tell the nurse that the computer was sampling the patient's physiological data, so don't disturb the patient until that green light goes out. The yellow light indicated there was some kind of a trend in one of the variables, maybe heart rate, cardiac output, or peripheral resistance, for example. The nurse then could press that light, which interrupted the computer and displayed a graph of what the trend was. The red light, of course, was an emergency, a cardiac arrest or something, requiring immediate attention.

We did everything in assembly language.

One day, I was down in the ICU, a 10-bed post-operative open-heart surgery ICU, and there was a nurse at the bedside taking the blood pressure with the cuff on one arm while in the other arm, we had a catheter recording the arterial blood pressure. I watched her, and she came back over to the nursing station, and I said, "Why were you taking that blood pressure with a cuff and stethoscope? We've already got it recorded right here." She really didn't know the

Courtesy of Stan Clark, Intermountain Healthcare.

Dr. Warner with his family. Front row: Homer's wife Kay Warner, Homer R. Warner, son Willard "Wid" on his mom's lap, daughter Jodi on Homer's lap. Children standing in rear from left to right Katherine "Kathy", Stephen "Steve", and Homer Warner Jr.

answer. She was frustrated. What it really amounted to is, we'd overwhelmed her with information. We had all this data, but we didn't know what it meant. So anyway, with this particular patient, there were some hemodynamic disturbances, and we called the resident, who came down. The patient had surgery a couple of days before, and we thought the patient probably had a cardiac tamponade. We called the surgeon, and he agreed, so they took the patient back and took care of it. And I thought, wouldn't it be nice if we could store that thought process we'd been through so the next time that set of events occurred, we'd recognize what it was, we could help that nurse, and she wouldn't just have to try to process the data without any help.[29]

I stayed awake a lot of nights trying to think of what to do with that machine, because we had all that computing power, and a few very capable people to work with it, but it was a real challenge.

That was the beginning of the HELP system. With that idea, we went ahead and developed the first version of the HELP system. I wrote the code for that system while I was in Europe. I had two meetings in Europe, and I had time between those two meetings in Geneva. I had my mother with me, I took her on this trip, and she'd never been to Europe. So here was Mother in the hotel room with me. She was a very quiet little lady and didn't bother me a bit. But I worked night and day, and I wrote the code for that system and brought it home, and we implemented it and published it. But that was the beginning. Of course it wasn't anything like the real HELP system in use now, but it was a system that for the first time, incorporated decision logic into the database, so you had a knowledge base as well as a database.[32,33]

It was a system **that for the first** time, incorporated decision logic into the database, so you had a knowledge base as well as a database.

Of course, Al Pryor came along and built a very unique kind of time-sharing system that made it all possible. Up till that time, the time sharing was largely one of just simply allotting so many milliseconds to each user and switching automatically amongst the users. But we couldn't do that—we were sampling data sometimes at 200 times per second with an electrocardiogram, for instance. If you missed the timing on that, you distorted the signal, so there's no way you could tolerate that kind of a system. This lovely computer that we had, had an interrupt system that Al Pryor was able to incorporate into our time-sharing system and make it so that there were priorities to the different users based on how urgent the data was.

So anyway, lots of people contributed to the building of that HELP system. It became a showpiece for us. We had visitors from all over the world come to see what was happening, how we were doing it, and so on. It became a tool for graduate students like you to work on.[2,5,6]

DS ***Right, exactly.***

HW Lots of bright young people could use that kind of an infrastructure to do their research. It opened up the whole clinical domain for us and gave us some credibility with the clinicians, the hospital, and the hospital administrators because LDS Hospital had become a "pioneer" in the application of computers to clinical medicine. They were all tickled with what we'd done. So that was a very exciting period, I think.

DS ***I'll say.***

HW And then it's still going on. They're now working on new versions of HELP, new hardware, and they've incorporated all the outpatient needs and so on. Order entry has always been a tough thing. We didn't attack that problem initially, and I think that's probably one of the wisest things we did, to recognize early in the game that physicians aren't going to be very happy about entering data into the computer. But they're happy to get the results and analysis of those results back.

The whole secret to it was having the right people. We've had a crew; you look at people like John D. Morgan, for instance. Here's John, who comes in as a graduate student and did his thesis on automating the laboratory and helping to automate some of the coding in medical records. Then he stayed on as faculty for a few years, but he wasn't really an academician. That isn't what he wanted, so he quit and started his own business, invested his own personal money into a little minicomputer and went around the country showing this to people. Pretty soon, most of the hospitals in the country were using his system. He turned around and gave us a $100,000 grant, which we're still using interest from to help support an outstanding graduate student each year. So we've had some wonderful success stories, bright people who've come along.

Now Paul Clayton's left us. [Reed Gardner notes: He originally left to establish the medical informatics department at Columbia, then came back to Intermountain, then left again to go on a mission.] The story of how he came to me might be sort of interesting.

DS ***Absolutely, I'd love that.***

HW One day, he came to my lab; somebody had told him what we were doing up there. He'd just finished his PhD in astrophysics at the University of Arizona. He didn't have a job opportunity, so somebody said, "Well, you need to go talk to Dr. Warner up at LDS Hospital." So he came up, and we had a chat, and he told me what his thesis was about, how he'd approached it. It turned out that in getting his research done at Tucson, he used much of the same technology we were using. He was following the fluctuations in the border of the sun, using video methods linked to a computer; we were using the same kind of methods to follow variations in the left ventricle after injection of a radiopaque, to follow the dye motion and characterize normal and abnormal contractions in the left ventricle. So, Paul fit in quite well, and within a very short time he was speaking "medical-ese" and talking to doctors, and he made friends very easily and made very nice contributions in our department before he left to go to Columbia. It's fun to reminisce about people, the bright young pioneers in the field of Medical Informatics.

> Wouldn't it be nice if we could store that thought process we'd been through so the next time that set of events occurred, we'd recognize what it was, we could help that nurse, and she wouldn't just have to try to process the data without any help.

DS ***Yeah, you've had a lot of really good people come through here, that's for sure.***

HW Yeah, lots of good people.

DS ***So you've answered a lot of the questions I was going to talk about.***

HW Well, I have probably just said everything I know!

DS ***No, you haven't. You've done a few more things you might have forgotten about. So tell me about when you created the Department of—I guess it was first called Medical Biophysics and Computing. It sounds like you were really doing physiology or what I'd call bioengineering research before that.***

> The whole secret to it was having the right people.

HW Oh, yeah. Originally, we called it Biophysics and Bioengineering. And that came about when the Dean of the graduate school was Henry Eyring, a world famous chemist. He was a good friend. He'd asked me on several occasions to make presentations to his graduate students on some of the things we were doing. One day, we rode home from a trip on the airplane together, and he said, "You know, you really ought to make a department so your students would have some identification with what their training had been."[34] They were getting degrees in engineering, in all kinds of things that really didn't describe what they were trained in. And so, he brought together the Dean of Engineering and the Dean of Medicine and me, and we talked about it. They asked me what I'd prefer. I said, "Well, I'd really prefer Medicine. That's my background, and I'd be happy to be in the College of Engineering, if that's the way it works out."

Courtesy of Stan Huff, Intermountain Healthcare.

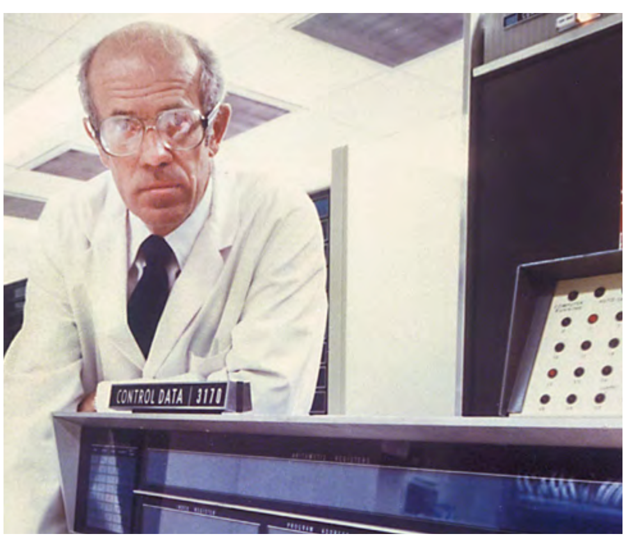
Biophysics, 1975; (back row L-R) Mark Scolnick, John Morgan, Hyrum Marshall, Peter Barber, Justin Clark, Reed Gardner; (front row L-R) Alan Toronto, Marion Dickman, Paul Clayton, Alan Pryor, Curtis Johnson, Homer Warner.

And that's what worked out. Turned out that the Dean of the College of Medicine said, "There's no precedent for a department that doesn't train MDs—having a pure PhD kind of training program is outside the tradition of our medical school." But the Engineering School was tickled about it. Bioengineering was something that had sort of caught on around the country at the time.

We formed the Department of Biophysics and Bioengineering and were supplied space in the Engineering building. We set up so we could do animal experiments over there, big dogs housed and experimented on in the Engineering School—it was quite a breakthrough. W. Sanford [Sam] Topham, who later became Head of Bioengineering at Western Reserve, was one of my first students. He joined the faculty, and he headed up that group that was at the Engineering School. Most of our activity at the time was still over at LDS Hospital, even though we were part of the University all this time.

So, Sam set that up, and that was the beginning of bioengineering there. A few years later, the Dean of Medicine changed, and the new Dean felt differently about us. He felt that we really should be located over at the medical school. So we did that. We broke up the Department into the Bioengineering Department in the Engineering School, and the Department of Medical Biophysics and Computing (which soon became the Department of Medical Informatics) moved administratively to the School of Medicine. We didn't move physically, we moved administratively, and we had a presence in the Medical School. So that was nice.

And then it really wasn't until the University of Utah Hospital became a customer for the HELP system that we actually moved faculty to the Medical School. When the HELP system began to mature and we got a lot of attention, both from NIH and from other institutions, it became apparent that we ought



AMIA Collen Award video in honor of Homer R. Warner.

Dr. Warner, ca. 1970s, in his laboratory coat, leaning on a Control Data Corporation (CDC) 3170 computer system.

Courtesy of Stan Clark, Intermountain Healthcare.

Homer on his sailboat.

to have some way of distributing this to other people. Then, NIH took it upon themselves to fund building two HELP-like systems: one at Massachusetts General and the other at George Washington University. Then, we encouraged some of our local people, including my brother [Rick Warner], to start a company here in Salt Lake City to supply such systems commercially. I figured that would give us employment opportunities for some of our graduates. We got the company, called MedLab, up and going. None of the faculty owned any stock in the company. We thought that having the LDS Hospital own part of the company might be a way of the hospital getting some returns on their investment and their support over the years.

So that company, largely funded by local investors, got off to a good start. They sold a number of systems, but every time they'd sell a system, they got further in debt, because you had to have the system about a year after the sale, before you really got it installed, everybody trained, and any income came from the installation. It was a drain on cash, and the company didn't have the cash. So to make a long story short, Control Data, who was one of the big investors in the company and who made the computer we used, bought out the other investors at a very cheap price, unfortunately. So the local investors didn't do very well. But Control Data bought out MedLab. Then they made a successful business out of it. The system has been installed since then, and eventually 3M bought it. But there have been copies of that in a lot of hospitals around the country, and even in Germany. Remember, Al Pryor and Reed Gardner took a three-month sabbatical and went over to Kiel in Northern Germany to help install one of the early HELP systems in a children's hospital.

Courtesy of Intermountain Healthcare.

Homer Warner, Al Pryor, Reed Gardner in the computer room at Intermountain Health. HELP was expanded throughout much of LDS Hospital over the following two decades, after its launch in 1967. While decision support remained the focus, automation benefits were realized as a byproduct, and a robust data base was developed.

DS ***Yeah, one of my friends got his PhD at that hospital, Ulrich Prokosch.***

HW Oh, yes!

DS ***Then Ulie ended up coming back over to Utah as well. So now he's a chief information officer and head of the Informatics Department at the University of Erlangen. But he was at the Institute for Medizin Informatik at the University of Giessen Hospital in Germany, where they had the HELP system, with Professor Jockheim Dudeck.***

HW That's right. Nice people.

DS ***I'll say. Very good friends, yeah. So the other thing I was interested in was, when you founded the journal Computers and Biomedical Research. That was an important event.***

HW At the time, I was Chairman of the NIH Computer Research Study Section. NIH had instituted a program in enzymology, where the advances were going so rapidly that they thought the information ought to be circulated much faster than it is in ordinary journals. And they had what they called the Information Exchange Group, among these enzymologists. Bruce D. Waxman, who was the Executive Secretary of this study section with computers, suggested that we do the same thing. So I did. I started this information exchange group, and NIH paid all the expenses for it. What we would do is, when you had a paper that was ready to submit for publication, you would then submit a copy to me. I'd send it to NIH. NIH would duplicate it and send it out to everybody who was on the list. Now, to get on the list, all you had to do was submit one paper yourself.

Here are these non-reviewed papers getting circulated, and the only risk was to your reputation. If something wasn't right, it was you that suffered. So it was fine, and the people who participated in it understood that. It went along fine for a couple of years. But then some of the journals got upset, particularly the Journal of Biological Chemistry. They got upset to the point where they refused to publish anything that had been circulated before it was sent to them. And so they shut us down, essentially.

When that happened, Bruce D. Waxman said, "We need a journal. Would you be willing to edit a journal?" And so we did. We worked out a deal with Academic Press and started the journal in March 1967. I called on 15 of my colleagues around the country who were leaders in the field, and that was the Editorial Board. So I edited the journal for 26 years, and it was a tremendous opportunity.

I suspect I've visited most of the institutions that were doing anything in informatics around the country.

I look back at my career, and I've really been blessed. You know, to get selected to be on an NIH study section is a wonderful thing, particularly in those days, because we made site visits, had the opportunity to talk to people who were doing research—not about what they had done, but what they were thinking about, what they were going to do, and why they were doing it. You asked questions, and you go into an institution like that, and tell them right off the bat, "Look, we are going back to a study section, and the two or three of us are going to have to represent you. We are going to have to sell your project to these other people, so we have to ask all kinds of things." They understand that. Talk about an educational experience! I mean, it was just wonderful. I suspect I've visited most of the institutions that were doing anything in informatics around the country, as a result of that wonderful opportunity. And a lot of the people in the field have had that kind of opportunity. So that was wonderful.

We'd have a lot of fun together, a **lot of good cross-** fertilization, I think, amongst our graduate students.

And of course editing the journal was another kind of thing. I'd get the articles before anybody else. I had the Editorial Board that I'd send them to, for review. They would give me their reviews, but ultimately, there would have to be somebody who said yes or no. I had to read enough of the article so that I felt confident that I really understood what they were doing and pass some kind of judgment on the manuscript.

So all those things just made it a very special time for me. I look back, and I'm just grateful for that point in time when all those opportunities came along. It's been a wonderful thing.

DS *The other thing that I was thinking about that was interesting was, we talked with Octo [Barnett]* earlier, and he was telling about how he met you, and you coming out to some of those study sites. Can you tell us a little bit about your relationship with Octo over the years?*

We decided to try to develop a teaching program. That's how we got into Iliad.

HW Octo is one of my best friends. We've really had a wonderful relationship. I think the first time I really got acquainted with Octo was when we made a site visit to Massachusetts General Hospital. Octo was a junior faculty person there. They were debating whether to move ahead with computerization, and what kind of person to get to head up this effort and so on. After the site visit, I felt so positive about Octo and how bright he was, and what his potential was, that I wrote a letter to the Administrator of the hospital—a prominent guy, I can't think of his name right now—but anyway, recommending Octo. Of course he got the job, and he's been in that job for a long time and made tremendous contributions.


Courtesy of Homer Warner, Jr.

Homer Warner, Jr. recalls, "For many years we took an annual vacation to Laguna Beach and stayed in the same rental home there. Happy memories."

DS *Absolutely.*

HW Wonderful friend. We've had a lot of fun together. He's been out to our place in St. George, and we've sailed to Victoria together on our boat. We've done a lot of fun things together. Yeah, he's a special guy.

DS *I'll say. He said the same thing about you. He was telling us stories about when you'd go to the meetings and then go to church together: go to the Mormon Church and then the Quaker Church.*

HW We did that, that's right.

DS *I like that.*

HW We'd always go to the—oh, golly, what's the name of the meeting before it became—.

DS *SCAMC?*

HW SCAMC, yeah. We'd go to SCAMC, and we'd walk over to a place where they had crab, where you can eat all the crab you want to. It's really a fun time. He'd bring his graduate students, and I'd bring mine, and we'd have a lot of fun together, a lot of good cross-fertilization, I think, amongst our graduate students. Did he explain that we had Iliad [Homer Warner's diagnostic program]? We did a lot of the same things along the way. And he really came from a cardiovascular kind of background, too, you know. So we had a lot in common.

DS *So, speaking of Iliad, I remember when I got to LDS Hospital, you left the Hospital and moved your office over to the University of Utah Medical Center and really started working on that Iliad program. Can you tell us about that?*

HW Well, the reason I moved from LDS Hospital to the University was because the University bought the HELP system. My friend Chase N. Peterson, MD, was President of the University of Utah, and he wrote me a note that said, "Well, we bought your system, what are you going to do about it?" In other words, "Aren't you going to come over and help?"

DS *Make sure it works.*

HW Yeah. I thought I'd send Al or Reed or one of the younger faculty members over there, but they said, "Oh, no, it's mainly a political kind of challenge, and you'd better go." So I gave up my career research award from NIH, and went over there with the intent of adapting that system to their needs. But that was one of the frustrations of my life, because I got over there, and the Dean of the College of Medicine was very good; he bought us a computer just like the one the LDS Hospital had—smaller, but the same machine. We were planning to find out what their specialties were and make whatever changes. But the fellow who was in charge of the IT for the hospital convinced the Hospital Administrator that if he let us get into the software, we were bound to ruin it, and they'd lose their warranty with Control Data, who produced it.

And after a while, when they begin to see the system performing like they perform, they realize that it's their knowledge that's making the system run, and they become excited about it.

DS ***Oh, goodness.***

HW So even though I had several good programmers that really knew the system very well, we were unable to do anything with that. And as a result, they only implemented the business part of the computer. They didn't really ever get into the clinical stuff. Unfortunately, the University became one of the least happy customers that bought our HELP system; it didn't work out. And that's how I got into doing other things in informatics.

Bill [William D.] Odell, who was Chairman of the Department of Medicine, asked me one day if there was something we could do with computers that would facilitate the medical clerkship. He said that the lectures they'd been given to supplement the experience of the student Heads on wards weren't well attended, and the faculty didn't like them, either. And so that was a special opportunity for us. We decided to try to develop a teaching program. That's how we got into Iliad.[35–39] It was a special set of circumstances, because there was a company called ALPS, Automatic Language Processing. It's technology out of BYU [Brigham Young University], facilitated language translation for industry. My brother Rick [Richard L. Warner] had financed that company. He was an auto dealer—he owned the largest Ford Dealership in Utah.

DS ***Yeah, I remember. He's the successful one in your family—is that the way your mother thinks of it?***

Courtesy of Stan Huff, Intermountain Healthcare.

Drs. Homer R. Warner and Stan Huff, now Chief Medical Informatics Officer of Intermountain Healthcare, at the dedication and opening night of the Intermountain Healthcare Homer R. Warner Center for Informatics Research, in 2011.

Courtesy of Stan Huff, Intermountain Healthcare.

Homer R. Warner, 2011.

HW That’s right. [laughter] No, I don’t think that’s the way Mother thought of it. She rather liked doctors better than anybody. But at any rate, he financed this company, and on the Board of Directors, they had a fellow, Ray Noorda—he was the CEO of the big networking company Novell.

He was a very capable guy and a very wealthy man. He was on the Board of Directors of ALPS, and was working with my brother. I told Richard that we couldn’t do this unless we got some people to support us, because we had to have somebody to pay the consultants. We had these one-hour sessions of knowledge engineering once or twice a week, with each of about 15 different subspecialists, the very best people of the Medical School. It was a wonderful thing to bring those people in and get them to interact with computers. Another educational opportunity occurred for me to better understand the broad scope of medical practice by having these subspecialists teach me about their fields, since I had never really been a practicing clinician. Here I had an opportunity to talk with these experts in each of these subspecialties about how they made a diagnosis. Unfortunately, that would have been the best thing for the medical students to do, too, so they could have all sat in on those knowledge engineering sessions—that would have been ideal.

> There aren’t very many people who are in academic medicine whose goal is to be a good teacher and care about the entire diagnostic process.

But at any rate, over this period of maybe six or eight years, we built the Iliad system, paying these consultants from the clinical specialties $50 an hour, which wasn’t very much, but it was enough to keep them coming. Eventually, they got so interested because it was their system. It’s really very interesting: You start off saying, “Gee, I don’t know anything about computers, what am I doing here?” And after a while, when they begin to see the system performing like they perform, they realize that it’s their knowledge that’s making the system run, and they become excited about it. So that’s how we got into Iliad.

So ALPS originally put up some money, and then Ray Noorda from Novell decided he wanted to buy Iliad. So he did. He actually hired my son, Homer Jr., to run that company, the little company that he built. He had a half a dozen of these little companies that he just spawned off. I only met the guy twice in my life. We didn’t ever have anything to do with him. But he had people that would provide the funds and run it. So that’s how it was financed. It was all financed with personal money from this

Courtesy of Stan Huff, Intermountain Healthcare.

Homer R. Warner at the podium at Intermountain Healthcare.

Courtesy of Stan Huff, Intermountain Healthcare.

Homer Warner, Jr. with Jeanne and Homer Warner.

company, but the evaluation of it was financed by a grant from NIH.

Once we got it up to where we could begin using it, we integrated it into the teaching for the medical students. During their 12 weeks on Medicine, they were required to use Iliad at the bedside to solve their real diagnostic problems with real patients, and also to solve two teaching and one testing case and a simulated case on Iliad. Now, those simulated cases were really real cases that we'd generated. We could make them more or less difficult according to what the professor wanted.

We did some of these experiments on ourselves.

We tried to evaluate it. It's a very difficult field to evaluate because you say, it's better than what? You start trying to ask yourself. So what we finally did, we decided we really can't tell whether this experience using a Bayesian approach is going to teach the student to be a better diagnostician, but we can tell whether the student learned something about diagnosing a particular disease that he's seeing with Iliad, better than he did with something he hasn't seen in a given specialty. So, unbeknownst to the students, two different groups of students would be assigned to maybe three subspecialties here, and the other group to another set of subspecialties they were being trained on. There were so many cases, they didn't really care or know—it didn't make a difference to their training. Then, we'd test them on cases in the specialties they'd been trained in, against the specialties they hadn't been trained in. With that kind of approach, we were able to show that it definitely was a worthwhile activity.

But unfortunately, again—it's an interesting lesson, Dean, what happens. When I retired, this was in full operation. Mike Lincoln was running the program. He'd train new students when they'd come on how to use it. Very straightforward. When I retired, William D. Odell, the Chairman of Medicine, retired as well. I went to Europe on a mission for the [Mormon] Church of Jesus Christ of Latter Day Saints, and the Chair of Medicine did not even know that Iliad existed, and Iliad was dropped just like that. It's very interesting, because now I teach a course, an elective for senior medical students in Medical Informatics, just to give them exposure to what's going on in the field and so on, and Iliad's part of that course content. We show them how to use Iliad in one of the sessions. They can't believe it and say, "Why aren't we using it? Why don't we have this?" But unless you've got somebody whose career is linked some way to development of such systems, who can say, "This is good for me," it doesn't happen. It's a strange business. There aren't very many people who are in academic medicine whose goal is to be a good teacher and care, in a generic way, about the entire diagnostic process. Instead, they are more concerned about their future and how many publications they can get, rather than developing diagnostic tools like Iliad. See what I mean? It's an interesting business; you wonder what's going to happen. In the future, somebody will come along and reinvent Iliad.

But they sold it. Soon after I left, Homer Jr. left that company, too, and went to work for another company, a laboratory company.

DS ***Oh yes, Sunquest.***

HW Sunquest. He worked for Sunquest for a number of years, and then went to 3M. So he left, and they sold the rights to market Iliad to a big publishing company. The University still owns it. While we were in Europe, I heard about it. But within a matter of months, they sold it to this outfit called ADAM. You can still find it on the Internet. It hasn't been updated, it hasn't been maintained. It sort of breaks my heart, because a lot of effort went into that. It was a lot of fun. You'd like to see something that works there that you could point to.

DS ***Do you have a few more minutes? You tired yet?***

HW I'm taking all your time.

DS ***No, I'm okay. I had another question. You mentioned the SCAMC [Symposium on Computer Applications in Medical Care] meeting, and I know you were involved with helping to form the AMIA [American Medical Informatics Association] organization and ACMI [American College of Medical Informatics] and everything. That's one of Don Lindberg's* interests, recording what happened.***

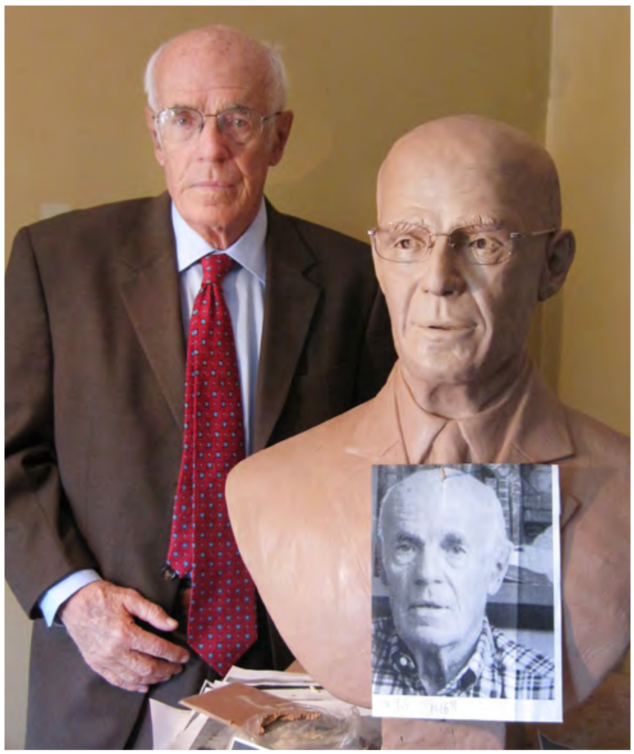
HW Well, as I remember it, I was on the Board along with Octo and Don and the other old guys in the field.

DS ***Yeah, there's a great picture of all of you guys.***

HW We were not that unhappy with the way things were going—I wasn't, anyway. I'm not much of an organization guy. But it's clear that there were those that did feel we needed to do something in order to bring together several groups so they could focus on one group. They also wanted to build a journal that had the name Medical Informatics. I'm really not sure where the name Medical Informatics came from. I can't trace that down. I think Europeans used it before we did. But anyway, they wanted to have a journal, they wanted to have a group that had a formal process. I think ACMI was an afterthought. I don't think that happened at the same time. But Helmuth Orthner, you know, was really at the grassroots of SCAMC, one of the chief players there. Octo, really, I would say, took the leadership role in making this thing real. In many of the discussions, he really dominated and did a great job at sort of directing it.

One time, Bill [William S.] Yamamoto—do you know him?

DS Yeah, I think I met him once.



Courtesy of Stan Clark and Stan Huff, Intermountain Healthcare.

Homer R. Warner with the mold use to cast his sculpture.

HW He was at the University of Pennsylvania, but he was very much opposed to it. He was going to sue! He thought we were doing something illegal, that some way, this wasn't a legal thing to do.

DS Was he the head of another one of the organizations?

HW He was the head of SCAMC at that time. And he'd been involved in SCAMC for quite a while. I can't remember all the details—but I do remember it was sort of a bad thing, because his feelings were hurt by it. It was not a pleasant thing for any of us.

DS I can imagine.

HW It was too bad, but he felt very strongly about it. But yeah, I remember the meeting. I was not a leader in that sense, making it happen, by any means. I would say Octo and Don were the key people that did that, made that happen.

DS I was going to ask you what you were most proud of in your career, and you mentioned your peripheral vascular resistance controlling the cardiac output. Let's say that's one part of your career, the field of Biomedical Informatics.

HW I don't think anybody would even know that I did that.

DS Well, I know, that's a ways ago.

HW When you get to be my age, well, how are they going to remember Grandpa when he's gone? [chuckles] I don't know, I guess mostly I remember how lucky I have been and how many opportunities I've had. I always look forward to going to work. It's just exciting to see a new field blossom like that. I remember when we did that first simulation of the artery transfer function. Alan F. Toronto, who was working with me at the time, and I were really questioning whether we ought to publish this. We thought we had our hands on something like the microscope for the first time. We really thought, "Let's do some more work before we publish this, because we don't want everybody to hear about it before it's ready." Of course [laughs] nobody ever did, anyway. But we were that excited about it. We thought, "This is a whole new world opened up to us," because I am not a mathematician, you know. I love mathematics; I'm not really good at it but I enjoy it. But here you can solve differential equations without having to solve them analytically. All of a sudden, a whole world just opens up to you.

Now we can go in and do things quantitatively—before, people just observed things. Dr. Heymans in

Belgium received the Nobel Prize for discovering the carotid sinus. Well, all he found was that as the arterial pressure increased, there was an increase in the firing of nerve fibers originating from the carotid sinus. Our contribution was to develop a dynamic and quantitative model that described the nerve firings emitting from the carotid sinus body. Later, we developed a model for the sino auricular [SA] node in the heart. Some years later, we found out that we were the first ones to "model" that body.

We did some of these experiments on ourselves. We made a catheter with a wire down the middle of it and a piece of solder on the end. We inserted that catheter in ourselves, and we put it down into the right atrium, up against the wall of the atrium. Then, we could stimulate the atrium and drive the heart to whatever rate you wanted within certain limits. You couldn't slow the heart down, but you could speed it up. So we were interested in the question, does increasing the heart rate affect cardiac output? In a normal guy like you, as you exercise, your stroke volume stays about the same and your heart rate will double. So we tried that. While we were at rest we put the catheter into the atrium and increased the heart rate. We then measured the cardiac output at different heart rates. We found that we could change the heart rate from 60 up to 120, and the cardiac output stayed exactly the same. Isn't that interesting?[40]

DS ***Yeah, that is interesting?***

HW Yeah, it's very interesting.

DS ***So I guess the stroke volume just goes down, because the heart doesn't fill up.***

Courtesy of Stan Huff, Intermountain Healthcare.

Homer R. Warner with the sculpture cast in his honor for the dedication of the Intermountain Healthcare Homer R. Warner Center fir Informatics Research, ca. 2011.

HW Oh, yeah. Well, the thing that determines cardiac output is the peripheral resistance. I've got heart failure myself right now, and I take a beta blocker. Well, what a beta blocker does is virtually dilate the arteries. That's exactly what I was doing, taking a load off the heart, you see. The cardiovascular system is amazing, because it is a pressure-regulated system. There are no flow detectors in the system. What happens is, the metabolism in the muscle, as soon as you exercise, as soon as that muscle contracts once, the CO2, the lactic acid, builds up, and capillaries dilate. No question about it. August Krogh, [Nobel Laureate 1920] one of the old physiologists, a Danish fellow, showed that principal in frogs, way back around 1920. If you have the two hind legs of a frog, and you stimulate the motor nerve to one of them, then you sacrifice the frog immediately and quickly freeze it, then look at the frozen cross-sections under a microscope, the exercising muscle will have over 100 times more capillaries open than the non-exercising leg. Can you imagine that? Now obviously, they're not the same hundred capillaries all the time. The capillaries in the tissue are opening and closing all the time. It's a dynamic thing. It's an amazing system.

The models that we build with a computer, the models we build in informatics, are useful because they're quantitative. We can do things you can't do with the unaided human mind.

DS ***Amazing how this works, isn't it?***

HW Oh, it is amazing. Anyway, that fascinated me. In informatics, I used to worry about whether the models that we built were unique. Along about 1970 or so, I was invited, along with Earl Wood and another physiologist whose name I can't think of from the University of Pennsylvania, to the Rand Corporation. Do you know that outfit?

DS ***Yeah.***

HW The fellow down there, who was in charge, was a very famous mathematician, Robert E. Bellman. He developed what we called dynamic programming. He was a very bright guy. He invited us down to talk about what we were doing, because we were all doing quantitative things in physiology. They had these physicists and mathematicians that had been so valuable during the war, and they wanted to find some way to use them for something else now. So we went down, and we spent a week down there—just the three of us.

One night, we were over at this mathematician's home, and I raised this question with him. I said, "One of the things I'm worried about, I've got these models that we build, and accept the data and so on. How do you know whether a model's unique?" He said, "There's no such thing as a unique model." "Well, how do you judge a model, how good it is?" "Well, it's strictly on aesthetic grounds." He then brought some of the physicists in to talk about different theories about life and so on. You judge the model based on whether it's simple, does it fit the facts, is there a one-to-one relationship with your reality, is it useful, and so on. Well, that was an eye-opener for me. I quit worrying about that. It's true, models are gross oversimplifications of the real world, but they're very useful. The models that we build with a computer, the models we build in informatics, are useful because they're quantitative. We can do things you can't do with the unaided human mind. You can't really do those things without a computer. The concept, for instance, of stroke volume was useless until we got the computer. All of a sudden now, we're using the computational capabilities provided by the computer as the central focus for our entire patient monitoring. However, we quit using the pressure pulse method to calculate stroke volume. Do you know why?

Morrie Collen had **an influence on** us—no question about that.

DS *I think so.*

HW You remember Rob [Robert] M. Cundick, Jr.?

DS *No, I don't know him.*

HW He was a graduate student in our Department. We used the pressure pulse method for years as the basis for our cardiac output measurements. We'd calibrate it against the dye dilution curve measure of cardiac output. Then, we'd measure the changes in the patient. But we found that some of the patients, about 1 in 20, would drift off, and it would give you a bad index as to which way the cardiac output was changing. Rob Cundick did a PhD dissertation on the topic, trying to reproduce what I had found in animals and in normal subjects, but he never could. The method was unreliable enough that we quit using it. It was unfortunate, and it's still a challenge to me to know why on earth things changed.

It is the people that make the difference.

DS *I heard Reed say one time that he spent a long time chasing that problem with you. He said something like, it seemed like the capacitance or the stiffness of the heart was changing somehow, and you couldn't tell when that was happening.*

HW Yes, that's right. We just could never do it. Rob worked on that for several years, and there really was no good answer for it. So, you win some and you lose some.

DS *You mentioned Octo Barnett and the Ledley and Lusted paper[24] and some other people. Were there other people who had big effects on your life and your career and the directions you were taking?*

HW Well, Morrie [Morris F.] Collen* did. I don't even remember—probably before your time—but we instituted an admission screening laboratory at LDS Hospital, inspired by his work.

DS *He'd done that same thing at Kaiser, I think.*

HW He'd done the same kind of thing, only not nearly as sophisticated as we then made ours. We had a lot of physiological measurements. We had blood pressure measurements, and we had forced vital capacity spirometry, and ECGs.[41] All that was automated and computer driven, and we had an automated patient history.[42] What Dr. Collen had was looking at the same kind of thing, only his was all done with punch-card input. They'd fill out forms and put it in—that sort of thing. But it was his papers that gave us the idea of doing multiphasic screening. That was very successful, up to the point where the payment system for medicine changed. The hospital could no longer charge for that. It became an expense instead of a profit source for the hospital, so they stopped it. It wasn't particularly because it wasn't good for the patient, because we discovered a lot of problems that made them postpone surgery, because they found these patients had a problem they hadn't recognized earlier. But, yeah, Morrie Collen had an influence on us—no question about that.

And I think Ted Shortliffe had some influence on us. I remember him inviting me down to Stanford to talk about the HELP system once. I'd always been sort of a critic of artificial intelligence, and the whole notion of it. I think it's far-fetched. None of that stuff really came to fruition, but it was stimulating, an idea that was very interesting. I think Ted's done some good things, even though they're more on the theoretical level, and we've been over on the practical end. It takes both.

I look at this little machine I've got in my pocket, and I've got a thousand times more memory in this than we had in that machine that ran the whole hospital information system 16 years ago.

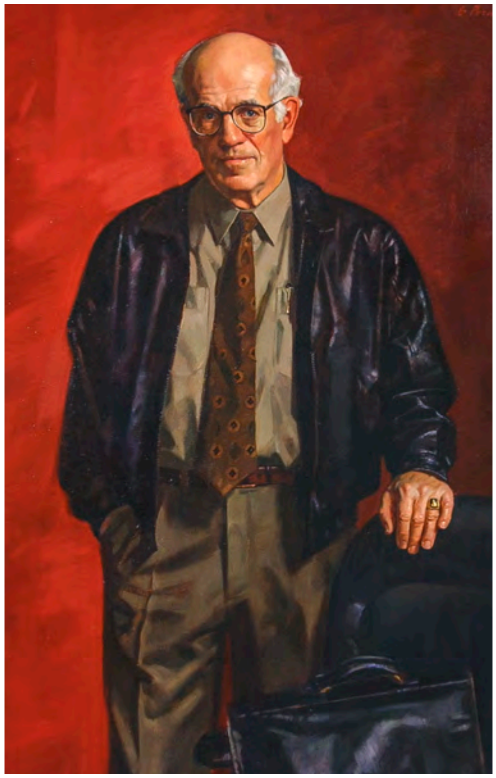
DS *I know there was some tension when I was a graduate student, it seemed like, between the groups at Stanford and Utah. I know Reed Gardner one time said that Ted Shortliffe said, "Well, you guys are just a bunch of engineers!" He meant it as sort of a put-down, and Reed said he took that as the biggest compliment he*

had ever gotten. So I guess everyone was happy, at least.

HW [laughs] That's right.

DS ***You mentioned one of your biggest disappointments was that the HELP system didn't work at the University of Utah Hospital. Would you say that was the thing that surprised you the most?***

HW Yeah, that was one of them. You know, you learn a lesson from all your experiences. The lesson is that "it is the people that make the difference." You know, you've got a new tool that may look great to you, but unless somebody out there thinks it's in their best interest to use it, make money off of it, or whatever the motive might be, it's not going to survive. That's a little disappointing. That's not an idealistic way to go, but it works. It's the free enterprise system, in a sense. I guess that's why I fall back, in a sense, on our modeling in the physiological domain as a more rewarding kind of thing in the long haul—because, you know, somebody else is going to improve on it. And that's fine, it's a stepping stone. Everybody's working on it, and you make a little contribution here, and somebody else makes it better there. You know, you look at Randy [Randolph] A. Miller, for instance, what happened to QMR? [Quick Medical Reference[44,45]—Reed Gardner noted in 2015 that QMR inspired Homer Warner to create Iliad.] He leaves Pittsburgh, and it's dead. It's the same story, isn't it?



Courtesy of the Spencer S. Eccles Health Sciences Library, the University of Utah.

Portrait of Dr. Homer R. Warner, painted by internationally acclaimed artist Galina Perova.

DS ***Yup.***

HW You think of the years that went into the QMR effort. It was a wonderful thing, stimulating, everybody was interested in it, and it provided a lot of intellectual fodder for the whole community and the whole field. But now it is apparently dead. [chuckles] But that's what life's about—it's about the journey, it's not about the end product, I don't think.

DS ***I was going to ask you if you had any words of wisdom for people that are new, coming into the field. Maybe you just said them already, but I'll give you another chance.***

HW I look at this little machine I've got in my pocket, and I've got a thousand times more memory in this than we had in that machine that ran the whole hospital information system 16 years ago. It's a thousand times faster, and it costs a thousand times less. You know, that's pretty exciting. Now, how can anybody not be enthused about where this field's going? You've just got to think about it, think about the Internet and all the things that are happening, and the impact it's had. So, the opportunities for doing things are greater than they have ever been. It's a tremendous field.[43] I really think that—and I hate to keep referring back to the modeling—but I really think that's going to be the big contribution that computers are going to make. It's going to allow us to build models to help us understand the world around us, and take advantage of these resources that we have.

DS ***I think people are doing that.***

HW Oh, I do too. Look what's happening in imaging—just an example of it. That has revolutionized medicine. It's had a tremendous impact. Guys like Dennis L. Parker are doing a tremendous job. I don't know where it's all going to go. I guess if I had a wish, it would be to be 30 years younger and able to see what's going to happen.

DS ***Wouldn't that be fun, huh?***

HW It's going to be exciting. It's tremendous.

DS ***You know David M. Eddy, he's a physician, and he works with Kaiser Health Care a lot. He's built***

some huge models of diabetic care that model all the way down from the cellular level of diabetes, all the way up to the institutional level. And so he models thousands of patients who have heart problems and they have diabetes, and then they come to clinics, and you have parking problems and flow problems. He's made some tremendous discoveries. He's been able to duplicate some of these huge trials that they've run, where they run a 10-year clinical trial with 40,000 patients. They cost something like $150 million, and he shows that putting the same input conditions into his model, he draws the same survival curves as these studies do. He's getting a lot of attention now with this kind of a model, and he's trying to build it in some other diseases to try to understand these diseases.

HW He's an interesting guy. I don't know him personally, but I remember we had him as the keynote speaker once at the SCAMC meeting. Very stimulating.

DS ***Yeah. He reminds me a lot of you—he's a mathematician and a doctor as well, just like you, building these models.***

HW Very interesting guy.

DS ***Well, I can't thank you enough. This has just been wonderful.***

HW Well, it was nice to visit with you again.

DS ***Yeah, really good to see you. I'm glad you're doing well. Reed says you're still going to the seminar, and teaching a class, and other things.***

HW Well, I get up there a little bit. You've got to have something to keep you stimulated. I've been working with Alan H. Morris a little bit. He's been working with these protocols to manage clinical trials. He's now got a nice grant, a million-dollar grant to disseminate these "tools," we call them, that really Dean Sorenson has built, and he's been testing and using for years. But disseminate that to these 25 institutions and show that they really can facilitate the clinical trials, you know. They control all the variables that otherwise are just random, and you have to have a lot more patients to get the same result. So that's been fun. That's about it.

DS ***Well, this has just been wonderful, and I certainly thank you, and everyone else will thank you as well.***

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For additional Conversations with Medical Informatics Pioneers, please visit:

http://lhncbc.nlm.nih.gov/project/medical-informatics-pioneers

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