



ORAL HISTORY PROJECT

**Abraham M.
Rudolph, MD**

**Interviewed by
M. L. Podolsky, MD**

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San Francisco, California

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PREFACE

Oral history has its roots in the sharing of stories which has occurred throughout the centuries. It is a primary source of historical data, gathering information from living individuals via recorded interviews. Outstanding pediatricians and other leaders in child health care are being interviewed as part of the Oral History Project at the Pediatric History Center of the American Academy of Pediatrics. Under the direction of the Historical Archives Advisory Committee, its purpose is to record and preserve the recollections of those who have made important contributions to the advancement of the health care of children through the collection of spoken memories and personal narrations.

This volume is the written record of one oral history interview. The reader is reminded that this is a verbatim transcript of spoken rather than written prose. It is intended to supplement other available sources of information about the individuals, organizations, institutions, and events which are discussed. The use of face-to-face interviews provides a unique opportunity to capture a firsthand, eyewitness account of events in an interactive session. Its importance lies less in the recitation of facts, names, and dates than in the interpretation of these by the speaker.

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ABOUT THE INTERVIEWER

M. L. Podolsky, MD

Dr. M. L. Podolsky received his MD from Chicago Medical School in 1945. Following his internship and post-graduate training at Baylor University Medical School, Sea View Hospital in Staten Island, and at La Rabida Sanitorium, Chicago, he was certified by the American Board of Pediatrics in 1955 and became a fellow of the American Academy of Pediatrics in 1960. For many years, as a member of the Academy's Indian Health Committee, he was an activist for better health care of Alaskan and American Indians. He practiced pediatrics and allergy in Belmont, California, for over 30 years and held clinical and teaching appointments at Stanford University Medical Center, Mills, Sequoia, and Chope Hospitals.

He was a commissioned officer, captain, in the U.S. Army and attended the Medical Field Service School at Fort Sam Houston, Texas. Most of his military life was spent as chief of medicine and pediatrics at the U.S. Army Hospital in Baumholder, Germany.

In addition to extensive medical, pedagogic, and writing activities he has held numerous civic and political offices. He served as mayor, councilman, planning commissioner, environmental officer, and chairman of the Noise Abatement Committee in the city of Belmont. From 1967 to 1972 he served on the San Francisco Bay Area Air Pollution Control District both as a member of the Board of Directors and as a member of its Science Advisory Council. He also was a member of the San Mateo County Environmental Quality Control Commission. He engaged in civic improvement work as a member of the Lion's Club and flew with the Flying Samaritans, bringing medical help to Indians in remote and primitive parts of the United States and Mexico. He served on the Human Rights Committee that regulates and monitors experimentation on humans in Veterans Administration Hospitals and acted as a consultant to the pharmaceutical industry on the implementation of federal statutes pertaining to protocols and the use of animals for experimentation.

Interview of Abraham Morris Rudolph, MD

DR. PODOLSKY: This is Dr. M. L. Podolsky, conducting an interview on Dr. Abraham Rudolph on August 30th, 1996, a Friday, at his home in San Francisco, 1125 Clayton Street.

DR. RUDOLPH: Where do you want me to start?

DR. PODOLSKY: Start with family background, and let's go from there.

DR. RUDOLPH: Ok. I'm Abe Rudolph. I was born in Johannesburg, South Africa. My father came to South Africa in about 1898, and he arrived there from a shtetl near Vilna, Lithuania. He left because of the induction of young Jewish boys into the Russian army. He traveled across Europe and worked on farms, and, this was when he was about 13 years old. He arrived in Germany and then traveled across to England, where he took the first boat, which took him to South Africa. He worked in a store in Johannesburg, and then eventually became the owner of the store. My father was the owner of this store until he died.

My mother was born in Capetown, South Africa, and then traveled up to Johannesburg where she married my father. There are five children in the family, the oldest, my brother, Arnold, or Jack Rudolph, as he's known, just died about a year and a bit ago. He was a neonatologist in charge of the neonatal program at Baylor [College of Medicine] in Houston. I then have two sisters, both of whom are still in South Africa. I am the fourth child in the family. My youngest sibling is my younger brother Nathan, who is now in New York and he is a neonatologist as well, in the program at [SUNY] Downstate [Medical Center].

When people ask me how was it that I went into medicine, I really cannot answer that with assurance. My older brother went to medical school, and when he was in medical school I was quite determined that that was the last thing in the world I wanted to do. When I began to look at other options, I was terribly interested in chemical engineering, but decided that there was really not much future in it for me. Eventually I gradually became influenced by my brother's enthusiasm about medicine, and that's what I decided to do.

Our family were not at all well off financially, so in order for me to be able to go to university it was necessary for me to obtain scholarships, which fortunately I was able to do. When I first started with medical school, I was really not comfortable, particularly in the second year. In the first year of medical school

in South Africa, we did not do any of the subjects which are now considered to be part of medical school. We did zoology, botany, physics and chemistry. Anatomy was what was done in the second year together with physiology. So when I began to really get involved in medical school with anatomy and dissection of cadaver, I was really very uncomfortable and I wasn't really quite sure that I could continue. But I gradually overcame that and became very enthusiastic about my interest in medicine.

Well, I found that there was quite a lot of pressure on me to do well in medical school because I realized that to be able to continue I had to obtain scholarships, and therefore I applied myself very hard to the studies. When I finished medical school, I did what was then usual in South Africa after medical school, and that is to do an internship, which was a six-month internship. Unfortunately, I was too young to get a medical degree because it was necessary to be 22 and I had not reached that age, so I could not become a physician. So what I did was I spent six months as an instructor in anatomy. And that was a very useful and interesting experience because that was what first really got me interested in teaching. So, although at the time I felt it was a disaster not to be able to start directly with my internship, in many ways it was a very good development.

Now the other problem I had, of course, was because I had been delayed for six months I was not able to get the position that I wanted, which was a position in the professorial team in medicine. So I was quite disappointed when I had to work in one of the other groups, the so-called "firms," but the physician with whom I worked, this was in medicine, was really a wonderful person who really also was a superb teacher and, again, got me interested in teaching. His name was Henry Heimann.

PAUSE IN TAPE

DR. RUDOLPH: During my work in internal medicine, as an intern, I became acquainted with a man, a surgeon, whom I'd always admired because he had written a book on surgical anatomy which I had been very interested in. And I was really very pleased when he accepted me to do a surgical internship. And then I really became extremely interested in surgery; I enjoyed my internship in surgery enormously. This man was also a superb teacher and a wonderful clinician, so when he asked me to continue in surgery and he offered to financially help me to continue my studies in the United States, I was delighted. But I said to him that I felt it was important to me, particularly since at that time my brother had become a pediatrician, to at least spend six months working with children just to see what it was all about and what my brother found so exciting about that. So we agreed that I would do six months of

internship in pediatrics.

So I obtained a position as an intern in pediatrics at the [Transvaal Memorial] Hospital for Children in Johannesburg and once I started that I just did not want to do anything else. I just was so thrilled with working with children that I decided that, even though I had this wonderful opportunity to continue my work in surgery, I just couldn't do it. So I worked as an intern in pediatrics for six months. All these positions in the hospitals as a "resident," which were intern positions, were six months positions. So after six months I managed to get a position as a so-called casualty officer, which these days would be equivalent to working in an emergency room. I worked for almost a year in the emergency room and I really found that terribly exciting and I just enjoyed it enormously.

In South Africa at that time if you wanted to go into some special area such as pediatrics, one had to "specialize." Since there was no postgraduate degree at that time in South Africa, this usually meant one had to go to England, because that was the affiliation that South Africa had, and do further postgraduate work. And there were several options; the one was to obtain a position as an intern in an English hospital or to obtain a position as a so-called registrar, which was more like a senior resident type position. The difficulty I had at that time was that I had no money. When I worked as an intern, although we had our board, we were being paid about five pounds a month, which was equivalent to about \$15 a month. So it didn't provide us with an opportunity to get much of an income. So I worked in this position as a casualty officer and managed to accumulate some money.

At that time, I became involved with my wife. She was a medical student, whom I had tutored when I was an instructor in anatomy. And I was very torn because I wanted to go and do my postgraduate degrees in London, and yet we were talking about getting married. She was an intern at that time. So what we agreed to do was that she would finish off her internship, I would go off to England and get my postgraduate degrees and then I would come back and we'd get married. So we did that. She worked as an intern in pediatrics at a hospital called Coronation [Hospital], which was affiliated with the University [of Witwatersrand]. It was a Black hospital.

I went off to England. Now because I had very little money I couldn't do courses because that required payment. So I entered the examinations and hoped that I would be able to pass these examinations. And I did pass the membership of the Royal College of Physicians of London and of Edinburgh. I was in England for a total of about nine months. It was all I could afford.

Then I decided to go on this short vacation to Sweden and visit with somebody

there who was working in pediatric cardiology. At that time, this was in 1949, there was no such thing as pediatric cardiology. And at Great Ormond Street [Hospital], there was a man who was doing some work in heart disease in children, but not very much. His name was [Richard] Bonham-Carter. He mentioned that there was a man in Sweden who was working in pediatric cardiology and whom he thought very highly of. So I went over to Stockholm and worked with a man called Edgar Mannheimer, who had done some work with Helen Taussig. And that's how I first got exposed to pediatric cardiology.

DR. PODOLSKY: Spell Mannheimer.

DR. RUDOLPH: It's M-A-N-N-H-E-I-M-E-R. Edgar. He was a really marvelous human being, just a wonderful person. I was this young nobody from Johannesburg, and he treated me just wonderfully well; he was just so kind and so helpful. That was just a wonderful experience. He eventually went to work in Ethiopia; the Swedes had some arrangement with Ethiopia, and unfortunately he died in a motor accident. But he was just a wonderful human being; I remember him really very fondly.

Anyhow, after that I was then in the position of having to go back to South Africa. I couldn't afford to stay on. I did not, incidentally, enjoy the British medicine at that time; I found that it was very constrained. They were very rigid, and I really didn't like the atmosphere. But the one thing it did do for me was made me decide both from the point of view of medicine, but particularly from the point of view of lifestyle, that I did not want to continue to live in South Africa. Having been exposed all my life to the situation where, you know, the Black was totally inferior, and coming to England and seeing this difference just made me realize that I couldn't live in South Africa any longer, as long as the political situation continued the way it was. Also, I thought that medicine in South Africa, from the point of view of open-mindedness, was much more advanced than it was in Britain at that time. I really wasn't too unhappy to go back to South Africa medically, but politically I was really quite upset. Also the thing that had really bothered me was that, in 1948, the Nationalist Party was voted into power in South Africa. That was [Daniel F.] Malan. I felt that that was the end of any hope for developing a reasonable society, so for that reason I really wanted to get out of South Africa.

I went back to Johannesburg; we got married within three weeks after I got back. My wife made all the arrangements. Then I managed to get a position as a registrar, which is a sort of senior resident, in Coronation Hospital, which was this Black hospital.

I really enjoyed working there, but I kept on being concerned about the fact

that I wanted to leave. So my wife agreed that we should leave. We had a baby on the way; she was born about a year after we got married. Then the question was, what do we do? How do we get out?

I decided I didn't want to go to England. So I wrote letters to Canada, different provinces of Canada, and I wrote letters to three places in the United States. I wrote to Children's Hospital of Boston; I wrote to Yale [University]; and I wrote to [Johns] Hopkins [University]. I just said, "I'd like to come and work." Well, the problems of course were that there was no reciprocation of medical licenses between South Africa and either Canada or the United States. So I tried to find out which Canadian provinces would recognize South African degrees, and the one that did recognize South African degrees was Alberta. But the more we read about the Alberta weather [laughs]; we decided that that wasn't a place that we wanted to go to.

So we waited and waited to get responses to my letters to the big centers in the United States, but I didn't hear anything. And then, it must have been about two, two and a half months, I got a letter from Children's Hospital of Boston, from the person who was professor at the time, Charlie [Charles A.] Janeway. He said that I could come on an unpaid fellowship. They couldn't offer me any money, but if I wanted to come and work I could do so. Unfortunately, they had had a rather bad experience with a couple of South Africans who had worked there, so they were not all that enthusiastic. But there was one person, a pediatrician from Boston, who had married a South African, and who came to work there. And they sort of said, "Well, South Africans weren't all that bad."

Anyhow, eventually we had to make this decision. By that time, we'd earned a little bit of money and we were trying to decide, could we manage to afford to come to the United States and work without salary? So, we decided to do that; we decided we could probably survive for about nine months. And we decided though that we would try to swing it and instead of coming on student visas we came on immigrant visas.

DR. PODOLSKY: What year was that?

DR. RUDOLPH: That was in 1951. We arrived in New York in August 1951, went up to Boston and started working at the Children's Hospital of Boston. Now I had been offered by Janeway the opportunity to work in either hematology, with Louis [K.] Diamond; or in neurology, with Bronson Crothers; or in cardiology, with Alex [Alexander] Nadas. I, of course knew the name of Diamond, and I thought that that's who I'd like to work with. But then, just after I came there, Janeway called me in and said he knew my financial status, and that he had a friend who was willing to provide a fellowship, for three

thousand dollars if I worked in cardiology. So I chose to work in cardiology.

I think I was very fortunate in that Alex Nadas had just recently, about a year before, come to set up this program in pediatric cardiology at Children's Hospital of Boston. He had been working as a pediatrician. He originally came from Hungary and he had been working as a pediatrician in Springfield, Massachusetts. Then he came over to work in the Children's Hospital, and he was really building up this program. So I arrived there as he was building the program. It was a very nice time to be there as this was developing. Of course at that time Robert Gross was the pediatric cardiac surgeon of note and working on congenital heart disease. It was a very exciting time to be in this environment, and it was just a wonderful time working as a fellow in pediatric cardiology.

After working as a fellow for two years, I became more and more interested in the physiology. So I spoke with Alex Nadas and he arranged for a fellowship for me in the physiology department at Harvard, and I worked there with [A.] Clifford Barger. Now this was, again, a wonderful experience, because I've just been fortunate in having wonderful people who have been my mentors. Cliff Barger was a very great person. Not only was he a wonderful physiologist, but just a wonderful human being as well. He was very kind and treated me marvelously. So I spent two years working with him, and then I was invited back to Children's Hospital by Alex Nadas and Charlie Janeway to head up the cardiac catheterization laboratory. I worked there in that capacity for five years. And, again, I just had a wonderful experience. I just enjoyed all of it; I just really loved it.

Then, of course, the problem was that I wasn't earning much money. At that time, one didn't earn much in academic positions. Certainly at Harvard, one didn't earn much. At that time, we already had a second child, a son, who was born in 1953; and then in 1955 we had our third child, a son. So we were beginning to feel a little pressured about our financial situation.

When I was invited, in 1960, to go down to New York to Albert Einstein [College of Medicine], I really was very torn because I was enjoying my career in Boston so much. But really, to say it right out, it was the financial situation which persuaded me to go to New York. It wasn't that alone, because the person who negotiated with me for that was a wonderful person. He was chairman of the pediatric department at Albert Einstein, Henry Barnett; a really marvelous human being as well. He persuaded me that there was a wonderful opportunity. Albert Einstein had started a few years before as a medical school, and there was this tremendous excitement there, real enthusiasm and excitement. And that's what attracted me as well as the

financial situation. But the other thing that attracted me was that it was the opportunity to build my own program.

So I went to New York in 1960 and, again, we enjoyed it enormously. My wife had stopped working for a period of about eight, nine years while the children were growing up. But when we went to New York, she started working again in the medical school. I really enjoyed the opportunity to build up a program on my own. It was tough because there was tremendous competition for clinical material, but I really was able to further my teaching skills. There was a marvelous pediatrician who was a superb teacher, Lewis Fraad. He was just a really good role model for me as well, to get the enthusiasm about teaching residents and students.

[PAUSE IN TAPE]

DR. RUDOLPH: I should digress for a moment to mention that when I was in the physiology department at Harvard, I had really been stimulated to become interested in physiology of the circulation. After that, when I was in Children's Hospital as the director of the cardiac catheterization laboratory, I became more and more interested in physiology of the circulation. Particularly, I began to become interested in the problems surrounding infancy. At that time, there were relatively few places that were doing anything about infants with heart disease. Most of the stress was on older children, once they got beyond the age of about two or three years, or even four or five years. I was very struck, when I had been in Sweden, that there was a study, which had been stimulated by Edgar Mannheimer, to look at when children with heart disease died. I was really terribly struck with the observations, which subsequently were published, showing that most of the children died in early infancy. So I was always troubled by the fact that we were concentrating on treating these older children but weren't trying to do something about the very young ones, because that's where the major mortality was.

So I became more and more interested during that period in trying to understand something about babies, and took the opportunity one period when Alex Nadas was away on sabbatical leave to do catheterizations in small babies, which he was not enthusiastic about. [Laughs] But, you know, when the cat's away the mice will play. So I did some, and when he got back and saw that it could be done, he was just terribly enthusiastic about that; so we then really started to push for trying to understand more about infants. When I went to New York, to Albert Einstein, I began to do more and more research in the laboratory to try to understand something about the physiology of congenital heart disease. I had the good fortune to be able to visit Yale one day and to visit with Douglas Barron. Douglas Barron was this very marvelous individual

as well, who had worked with Joseph Barcroft in England, doing some of the very early work on fetal physiology.

DR. PODOLSKY: Spell those two names.

DR. RUDOLPH: Barron. B-A-R-R-O-N. And Barcroft, it's Douglas Barron, and Barcroft, Joseph Barcroft, B-A-R-C-R-O-F-T. Now, as a result of my visit with Barron, he really got me started on the interest in fetal physiology, and that's when I began to work on sheep fetuses to understand something about the circulation in the prenatal period. I enjoyed my experience at Albert Einstein enormously; I really liked it.

I was then approached by another individual who had a major impact on my life, and whom I just have an enormous respect and regard for; and that is Julius Comroe. Julius Comroe approached me one day at an NIH [National Institutes of Health] meeting, I was on a study section and he approached me and asked me if I would be interested in considering coming to San Francisco. I said, "Well, I'm not sure what you're talking about." So he sent me, as is so typical of him, this hand-written note saying that he and the Cardiovascular Research Institute had just received a grant for research. He thought that he could support my research; but he really wanted me to come and take on the responsibility of heading up the pediatric cardiology program.

DR. PODOLSKY: What year?

DR. RUDOLPH: I came to San Francisco in 1966; but of course this discussion went on in 1965. The more I talked with him, the more impressed I became with the institution. He was just such a wonderful individual. And there were so many disadvantages at that time to coming to San Francisco. First of all, there was no program to speak of in San Francisco. The pediatric cardiology program was really not well developed at all. The surgical results were not very good relative to the rest of the country at the time. So there was no great stimulus to come there from that point of view. The main stimulus though was that Julius Comroe was head of the Cardiovascular Research Institute, which was already becoming renowned as one of the major, if not *the* major research institute in the world. So I was quite torn. And I kept on telling Dr. Comroe, as did my wife, that we really loved living in New York, because we had all these wonderful cultural activities we could participate in. We really enjoyed it. We didn't live in Manhattan, we lived up in New Rochelle, but it was easy commuting into Manhattan. And we really did enjoy living there.

So he was sending us these letters. He's tear out the *Sunday Chronicle/Examiner* pink sheets showing us what was going on, and saying that

things were, after all, happening in San Francisco. [Laughs] And then he invited us out together and persuaded us that this was the thing to do. So I came to University of California, San Francisco in 1966. And the remarkable thing about this was that I was very concerned because I had a very well functioning research lab at Einstein, and work was going extremely well. We were very productive; I had received grants. It was very difficult to leave something like that. Well, Julius Comroe told me that he would see to it that if I told him what it was I needed, I would be able to start working within three months of my getting there. And that's exactly what happened. We were able to start working in the lab within three months of my getting here. So it was really quite remarkable, because that doesn't happen in most places. It was really very gratifying.

Since I've been in San Francisco, it's just been wonderful. Everything has been great. I've really enjoyed working in the Institute, which has been extremely supportive of the research. Julius Comroe was a really wonderful mentor to me. He had such enthusiasm about teaching and really stimulated me to recognize that one has to work at being a good teacher. And then the other thing that I found remarkable was that here was a man who had given up, to a large extent, his own individual personal research career to help other people work in research. That got me interested as well in trying to support younger people. And so much of what I've done relates to what I learned from him in regard to the enthusiasm of teaching and particularly of supporting people coming up along, younger people.

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DR. RUDOLPH: Well, once I got to San Francisco, at UC, there was a wonderful excitement here too, because Dr. Mel [Melvin] Grumbach had just come about six months prior to my arriving at the university, as chairman of pediatrics. He was building a very strong academic department. So it was really wonderful to be in this department at a time when there was this enormous academic growth. But I think that, although that was exciting, the thing that really was most important to me and for my career, was the association with Julius Comroe and the Cardiovascular Research Institute. Because there, he had developed this exciting environment in which there was tremendous cooperation and collaboration. People were working together and were very interested in helping one another. And it was just a marvelous environment in which to do research.

And this is where I began to work actively, really actively, in fetal research using the pregnant sheep model. Just before I left New York, we had begun to work on a research technique, which was quite novel and involved the use of

radioactive microspheres to study the circulation. It was possible in San Francisco to perfect this technique. We got to the point where we were then able to use the radioactive microsphere method for measuring blood flow to every organ in the fetal body. We were able to apply this to an enormous number of very exciting studies, which really helped to advance the knowledge about the fetal circulation, at a tremendously rapid pace. And that was an exceedingly exciting time.

It also resulted in us having a large number of people from many disciplines become interested in our laboratory. We had obstetricians who were interested in fetal physiology. Physiologists, as well as pediatricians, came and worked with us in the lab, which made it a wonderful cooperative venture with people from different disciplines. And I think that, in terms of the contributions, those that came from fetal physiology, which we were able to then extend into applying to humans, were the things that I found most exciting. For example, we were able to show in the sheep fetus that prostaglandins were important in ductus arteriosus regulation. From that we were then able to use prostaglandin synthesis inhibitors such as indomethacin to close the ductus arteriosus in pre-term infants. And that, I think, has had an incredible impact around the world. So that was one of the things I found so exciting about the research that we did in the lab.

Also using prostaglandin infusion in babies with heart disease to keep their ductus arteriosus open after birth, that too was just such a wonderful application of the research. That's what I've always found wonderful about the research, not just being able to do the basic work, but then being able to apply it. Seeing it applied was what I found so exciting about this whole aspect of my career.

Now, I think that when one looks at what's happened with congenital heart disease over the time that I've been involved with it, that's going back to 1951, it's really remarkable what has happened. The reason I went to Sweden, when I was still in the resident role, was that they had just started doing some cardiac surgery there. [Clarence] Craaford, that's C-R-A-A-F-O-R-D, had begun to operate on patients with coarctation of the aorta. But then when I got to Boston in 1951, Gross was operating on ductuses and then the exciting time came when he started to do intracardiac surgery. And one of the first techniques that he developed was this well technique for closing atrial septal defects; when you think about it it's really a rather crazy idea but it worked. This was a blind procedure in which, going through a rubber well attached to the atrium, the surgeon closed the atrial septal defect. It worked, but it wasn't very good. And then subsequently, I saw the development of cardiac bypass surgery. And then we began to see the closure of intracardiac defects.

But again, to me, the most exciting things have been the development of procedures to treat heart disease in infancy. Because, after all, that is still the major time of mortality, and if we really want to have an impact on heart disease in children, congenital heart disease, we have to do something in infancy period. Now I think we've got to the point where it's recognized that we have to operate in infancy on many of these patients with heart disease. And it's been marvelous to me in the latter stages of my career to see the phenomenal successes that are being achieved by Frank Hanley here at UCSF, in operating on infants with heart disease. Very complex cardiac lesions are being repaired in infancy. We used to operate on infants with heart disease, but many of those procedures were palliative procedures. Now more and more, the complete repair of the cardiac defects is being performed in infancy. This is very exciting, to see over my career the development of a history of heart disease in children, congenital heart disease; where we started off being able to offer almost nothing, and now are able to offer phenomenal success in treating these babies. So it's been a wonderful time to see all this develop.

Now it's not to say that we have got to the point where we have resolved all our problems. Because although there is enormous success in treating these babies, I don't think we can consider them cured. Many of them have what are not really complete repairs of their lesion; they still have problems. And I think we'll continue to see problems. But one of the things that I find is so complex is the fact that, in general, we still tend to think about medicine, and to think about pediatrics, as problems starting at birth. We have to recognize, like the Chinese do, that there's a whole period before birth, of nine months of life, and that a lot of things can happen during that period which can influence what happens after birth. And this is what is still one of my major interests, is what happens before birth in development of the circulation that can influence what happens after birth. Now, I think, even some of the cardiac surgeons are beginning to think about the possibility of doing something about lesions before birth. Because, in some situations, by the time the baby is born a cardiac lesion has resulted in such a lot of secondary damage that it's probably never reparable. For example, if you have a child who has an obstruction to, say, the pulmonary artery, severe pulmonary stenosis, before birth, the right ventricle may not develop. Now if you correct that lesion after birth, that right ventricle may never develop. But if you correct it before birth, maybe it could develop. That's the sort of thing that I think is a fascinating area for consideration at this time.

There are all sorts of other interesting things about growth of heart muscle. We know that the heart muscle grows differently before birth as compared to after birth in terms of cell proliferation versus hypertrophy of individual cells. And we need to know more about how the prenatal development will influence

postnatal development and long term survival, whether these individuals will have normal life spans even if corrected at birth. So I think we're beginning to get into the whole aspect, because I think technically it would not be too difficult to approach the fetus. We've done so in the sheep fetus; we operate on sheep fetuses at an early stage of gestation, and have them continue to develop in-utero. We study them in-utero. So I don't think it's going to be too long before the feasibility of surgery on fetuses becomes real.

That leads one, though, into some very interesting and difficult questions. Because ethically, should we be doing that? I'm not concerned so much about the approach to the fetus; but first, obviously there are risks to the mother. And should one put the mother at risk for the baby? That's a difficult issue. But I think the more important issues are related to the question as to whether we're going to be able to tolerate the expense of this sort of approach versus using our resources for other things, where we can probably get much more benefit to more people for the same amount of resources. So it becomes a very difficult question, but I think that's a question which is not specific to whether we approach fetal surgery or not, because I think it relates to so many of the things we are doing.

For example, to what extremes should we go in trying to keep premature infants alive? Where do we draw the line? I think these are issues which we've not really approached enough. We have to begin to approach them. When you think about the fact that even though we're able to keep pre-term infants alive; the tiny prematures, even if they do survive, such a high percentage of them really have serious problems. So I think these are important issues which we have to address.

Now the question is, how will we address them? Unfortunately, I think the problem is that the way that they're going to be addressed is not because we sit down and contemplate what is really appropriate and what isn't appropriate, and what should we be doing in terms of whether we can provide an individual with life and a reasonably good life. Instead we're going to be pressured into this by financial considerations. I really feel it's sad that this is what's pushing us to make decisions; that it's financial and not social thoughts that are going to really determine where we go in the future.

When I arrived at the University of California in San Francisco, my interest then was in developing a really strong pediatric cardiology program as well as a strong research program. I think that it also was one of the very few programs in pediatric cardiology training in which there was a major stress on the research component. Most of the other programs were training people in clinical assessment of heart disease, in the techniques of cardio-catheterization,

but very little attention was directed towards training people in research. I felt that in order for the field to advance it was essential that we train young people in research. Philosophically, I didn't feel, and I still don't feel, that everybody should be doing research. But I felt that a certain number of people, if they could be stimulated to going into research, could make tremendous contributions to our understanding of the problems of children with heart disease. So what I set out to do was to develop a program in which the research component was a very important part of the experience.

Now I think we've had a modicum of success in this because many of the people who trained with us have become really superb academic pediatric cardiologists with major research interests and activities. So I think it's paid off to really stress that component of the program. Now, along the line, I've enjoyed enormously doing both the clinical and the research aspects of cardiovascular physiology and congenital heart disease. Although I had been approached a number of times to consider chairmanships of pediatrics, I resisted it. Mainly because I did not want to be overwhelmed by administration; I wanted to continue to work not only as a supervisor but to be actively involved in research and clinical work. And I've fortunately been able to maintain that to this day.

There was one period, in 1986, when I was persuaded that I should take on the chairmanship of the pediatric department at UCSF. There was a period of difficulty within the department of morale, and it was felt that we needed to change direction. Well, I did not want to take on this position but suggested that we recruit a new chairman. But we were not successful in recruiting a new chairman from outside, so the dean persuaded me to take on this position as chairman of pediatrics, in which I served for a period from 1986 to 1991.

I think I did a good job, but I didn't enjoy it. [Laughs] I really enjoy much more the active involvement in patient care and in research, and I always have been actively involved in both. For example, in the research I still continue to do my own surgery in the fetal surgery lab. And I do most of the writing myself, even though research fellows in training have done the work with me. I really am still very actively involved in the work itself, in the interpretation, and in the writing of results. And the same applies in the clinical work. I had given up, when I became chairman, doing cardiac catheterization procedures myself because I felt that the more important thing that I could do with the time I had in clinical pediatric cardiology was to teach. So I really devoted my major time, when I was in pediatric cardiology, to teaching. And particularly teaching clinical pediatric cardiology.

So now what I do since I'm semi-retired is I concentrate on two things, and these are the things that have always been the greatest joys to me. The one is

to do research in the lab, and the second is to see patients. I also teach while I'm seeing patients, do clinical teaching. During my career, the research I've done has almost always been stimulated by some clinical problem. For example, the reason I first became interested in fetal physiology was because I felt that the problem of hyaline membrane disease was related to something that happened before birth. At the time that I began to become interested in this problem, I thought that interferences in the pulmonary circulation may be involved. I decided that if we were going to understand the changes in the pulmonary circulation after birth, we had to know something about what happened before birth. That's what really stimulated me at that time into trying to study the fetus; it was largely to study the fetal pulmonary circulation.

Once we developed the techniques of this radioactive microsphere technique; however, it opened up all sorts of vistas. It really got me started on trying to understand many aspects of fetal physiology. One thing that has always interested me is how the fetus responds to stress. So these studies that started off of trying to study the pulmonary circulation eventually led to a whole series of studies examining the ability and the mechanisms by which the fetus was able to respond to stress. That's been a major component of the research I've done over the years with a large number of wonderful, bright, young fellows, who've come to work with me in the lab. It's been, to me, one of the most gratifying aspects of working, to have enthusiastic, bright, young people, who are always challenging one's ideas, challenging one's approaches; it's really just extremely gratifying.

Now, subsequent to beginning to study a whole variety of different mechanisms of response of the fetus to stress, we began to really explore the ability to do detailed studies of physiology in the fetus. We began to develop more and more techniques for being able to do detailed studies of the physiology of the fetus, in-utero. I, for many years, had stressed that in order to study the fetus in as normal an environment as possible, we couldn't study the fetus outside the uterus. I felt it had to be studied as it developed in-utero, and that's why a good deal of effort was placed into developing techniques for studying the fetus in-utero. Prior to this, almost all the studies that had been done on the fetus were done on sheep fetuses that were studied acutely, removed from the uterus but still attached to the placenta. But our group began to really look at the feasibility of studying the fetus in the uterus, without any effects of drugs or anesthesia or any medications.

We first developed the approach of inserting catheters into the fetus and leaving them in, and being able to measure pressures and get blood samples while the fetus was still in the uterus. Subsequently, we became much bolder and we began to do things like operating on the fetal chest in utero, placing

instrumentation for measuring blood flows, a whole variety of procedures of that sort. And we began to realize that it was possible to approach the fetus and to do all sorts of things without disturbing it very much and allowing it to continue to develop. And that, of course, opened a whole vista of all sorts of fascinating studies that could be done in the fetus.

Because of my interest in the response to stress, we began to look at some of the biochemical and hormonal responses of the fetus to stress. We really did quite extensive work on this, both in regard to the ability of the liver to metabolize various substrates and to produce various substrates, as well as in studying the ontogeny of hormonal responses in the fetus, and the responses of these things to stress. More recently, we began to become interested in the changes that occur in the circulation after birth, and what is responsible for these changes, what the mechanisms are that are involved. Some of the things we've studied have had really tremendous impact clinically; I mentioned previously the studies on the ductus arteriosus and the role of prostaglandins in maintaining patency of the ductus in the fetus and permitting closure of the ductus after birth. That has, as I mentioned, been tremendously useful in applying that information to clinical work.

I also should mention that we really have done an enormous amount of work on the pulmonary circulation and the mechanisms which are responsible for the ability of the lungs to receive a tremendous increase in circulation after birth. We developed models for looking at this. We were able to simulate different aspects of the birth process in the fetus in-utero. For example, the birth process is a very complex process. In addition to the umbilical cord being cut, there is the onset of breathing; there is a change in temperature, the fetus comes out from the mother's temperature of 38° C into an environment where the temperature is much lower. In addition to just the physical aspect of breathing, the fetus also has a tremendous change in oxygenation, because prior to delivery, the fetal arterial pO₂ is in the neighborhood of about 20 millimeters of mercury, and then it goes up to 80 to 100 immediately after the birth. We wanted to try to understand what the role of each of these factors was in producing some of the changes at birth. For example, what is the effect of just breathing alone without any change in oxygen? What cutting the cord does; what decreasing temperature does; and what oxygenation does? And we studied all those in a model in the fetus in which we simulated each of these events while the fetus was still in the uterus. And it's really led to a far better understanding of some of the mechanisms responsible for the adaptations of the circulation and the lungs after birth.

Now, what I'm really most interested in recently, is to try to understand something about the development of heart muscle, and the changes which occur

in muscle after birth. I just alluded to it briefly before, but what's very interesting is that in the fetus, before birth, all heart muscle growth is by hyperplasia; that's increase in cell number. Within a week to ten days after birth, the heart grows, but it does not grow by hyperplasia, it grows predominantly by hypertrophy, that is increasing cell size. Now I've always found this fascinating, and I think there are tremendous implications that this change may have. For example, we have to consider the possibility that if there's a heart lesion in the fetus and a restriction in growth of heart muscle, and there is an arrest of the number of cells that develop, will this individual subsequently have a "normal heart" in terms of subsequent ability of the heart to perform? Because if the number of cells is limited, then after birth if growth is only by cell size, there must be a restriction in the total development of muscle. I think this becomes of even more importance when one considers the premature infant. Because if the pre-term infant is born with a certain complement of cell numbers, then what's going to happen after birth? Will this infant born prematurely eventually have a normal number of cells in the heart that can develop, or will this person subsequently be subject to early cardiac failure for various reasons? Now these are just questions; we don't know any answers to these, but I think it becomes a very important issue to answer these.

Another question that I think is a really interesting one: what is it that changes after birth? What we are talking about is a complete change in the phenotypic expression of the cell, from before birth to after birth, and what does this? It's something that happens around the time of birth; there are so many things that do happen around the time of birth, but it would be fascinating to know what this is. Now this is the sort of research that I'm working on now. To try to look at various possible mechanisms which may account for the change in the phenotypic expression of the heart muscle cell after birth.

Of course, there are other fascinating areas. We know that after birth if you stimulate a heart muscle by putting a workload on it, it increases its muscle mass. There is an increase in thickness of the ventricle, which is by hypertrophy, increasing cell size. Now the interesting question is, what happens if you put a stress on the heart before birth? This happens in many congenital heart lesions, so we've done some studies already where we've produced an obstruction to the pulmonary artery in the sheep fetus at a relatively early stage of gestation. Then we allowed the fetus to develop and, true enough, they develop tremendous increase in the size of the right ventricular muscle mass. But the fascinating thing is that this is all by hyperplasia, increasing cell numbers. So when the heart muscle is stressed before birth, it still undergoes the same type of response as it does in its normal growth. But now the fascinating question is what happens after birth to this muscle that has undergone this increase in cell number. And that's the sort of thing that I'm

now studying, to try to determine what the long term postnatal effects are of these changes before birth.

DR. PODOLSKY: We are now continuing the interview of Dr. Abraham Rudolph, and we are now on tape two, side one. Dr. Rudolph, you've had many positions, both in academia and as researcher as well as an administrator. You've worked with students and fellows throughout your career, so you must have some opinions as to how medical education and pediatric education and training should go. Will you tell us about it?

DR. RUDOLPH: Well, I'd like to start off by saying that I really feel that there's been a tremendous change in the process of pediatric education. And I think that, unfortunately, over my career what I've seen is a lack of maintenance of superb clinical training. When I first was exposed to clinical medicine, history taking and careful physical examination were considered the hallmarks of a good approach to a patient. I think, unfortunately, more and more what has developed, as a result of the use of increasing numbers of laboratory tests, is that a careful clinical examination is not frequently performed these days. I think that most of the clinical examinations that I see being performed by residents and colleagues are not really detailed, so that there's an increasing tendency to rely on lab reports.

I think that the result of this, as I see in the approach of residents in pediatrics, is that more and more management of patients is being done by rote. In other words, people have developed specific approaches for specific problems, and there is a tendency for these approaches to be applied without careful thinking about either the clinical examination or careful evaluation of the patient. I see this particularly in my own field of pediatric cardiology, where the application of techniques, particularly echocardiography, has resulted in the ability to obtain a fairly detailed analysis of cardiac lesions so that the clinical examination has become almost secondary. And I think this is unfortunate, because it was possible in a large percentage of patients to make a diagnosis by careful clinical examination and assessment of the clinical findings.

What I have felt is important in regard to teaching is that to be a good teacher one must always try to help the student to understand the mechanisms of what one is trying to evaluate. In other words, I think that if one just considers the clinical findings or a disease process, it's important not to just know the facts about them but to know something about the mechanisms underlying the development of abnormal clinical findings as well as the development of abnormal physiology.

What I really feel is important is to try to stimulate people to think about

pathophysiological mechanisms of disease. If one can understand the basis of disease process, then it's much easier to appreciate how this process will cause abnormal clinical findings or abnormal physiology. So I've always tried to stimulate an understanding of pathophysiology.

Now in heart disease, this is, of course, a very easy approach, because understanding abnormal cardiovascular physiology really helps tremendously to understand how this can cause various abnormal clinical findings in children with heart disease, and also to understand something about the abnormalities of the circulation. I think that it's really crucial, in order to understand how various congenital heart lesions affect the child, to know something about what the effect of this lesion is on the course of the circulation and how this may produce the various findings that one observes. So I've always tried to stress this aspect of education, that one must really push for understanding basic mechanisms.

DR. PODOLSKY: Dr. Rudolph, when I got out of medical school, a rotating internship was required. Now I understand many of the youngsters are getting out of school and going directly into residency or specialties. How would you think we ought to handle the young medical school graduate?

DR. RUDOLPH: As I have mentioned earlier, when I graduated from medical school I did an internship in general internal medicine and then an internship in surgery, before going into pediatrics. Now I feel that this was of tremendous value to me, to really get some exposure to aspects of medicine other than pediatrics before I became a pediatrician. I think, though, that the problem today is that by the time people have finished school and college and then medical school and then residency, they really are quite old. To then expect people to do further training in general medicine or surgery or some general aspect other than their specialty is really asking a great deal.

I think this is one of the real problems we have in our society at the moment, and that is that people are becoming older and older before they really begin on their career. So that if we try to extend education even more than we have at the moment, I think that people will be tired old men and women before they get to actually entering their real careers. So I don't know what the answer to this is. Perhaps what we may have to begin to do is to consider the possibility of tracking at a somewhat earlier stage in our careers. Now, the disadvantage of that is that it may tend to make people too specialized without any significant background. But, on the other hand, I think we've got to the point now where all aspects of medicine have become so complex that it's not possible for any one individual to become really expert in a whole variety of different areas of medicine.

It's interesting that what we're seeing now, with the development of health maintenance organizations and the various aspects of health care that we're providing at the moment, is that there is a tendency to go back to trying to make medicine more generalized and trying to stimulate the development of more family practitioners and to have less specialization. Now I think from one point of view that's an advantage because certainly it's an advantage to have a physician who one can consider one's family physician. On the other hand, I maintain that to provide high quality care, one still has to have some specialization. That's not to say that everybody has to become specialized. But I think we really need to recognize that if we are going to provide the sort of care that we've begun to expect in various disciplines, that we're going to have to train people in a highly specialized nature. I do not believe that we can provide that care without people who have been specially trained in certain areas.

Now, I must say that I am, as a pediatrician, very concerned about the trend towards a large increase in family practitioners, because I do not believe that children will get as high quality care from that group of physicians as they will from pediatricians. I think this is true across the board, not only in general pediatrics but in the specialty areas. At one time we used to see that when specialties were developed--this was, for example, in Great Britain--there were no pediatric cardiologists or pediatric anything. In the specialty areas, it was the internists who dominated the field, both in adults and in children. Now as we've seen the developments in this country, and I must say that the [American] Academy [of Pediatrics] has been very important in this area, we've seen the development of specialties in pediatrics. And I really don't feel that children can get the same care from a person who's trained and interested in treating adults predominantly as they can from somebody who has a particular bent toward children.

Now I mentioned that the Academy has been very important in this role, and historically I think if you look at the development of the specialties in pediatrics, it's largely through the Academy that these specialties have been stimulated in pediatrics. An example is pediatric cardiology through the Section on Cardiology that was developed in the Academy. There was where the first stimulus arose for developing specialization in pediatric cardiology with certification in pediatric cardiology. This, of course, has happened in many other areas, and I really think that that has resulted in superb care for children at all levels.

Now, it's very difficult because I suppose that the argument is that why can't a family practitioner deal with general pediatric care? For example, why can't

they deal with immunizations and all those sorts of aspects? And I think they could, but on the other hand I feel that a special understanding of the problems of children and their needs and of the diseases of children is still necessary to provide high quality care to children.

I think one of the real problems that we face in this regard though, is that with the economic pressures from health maintenance organizations to reduce the cost of care, there is going to be an increasing tendency, I believe, to reduce the number of specialty consultants within these groups. And the question is, how are we going to maintain the special aspects of child care? That's an area which I feel the Academy could really address, I think we really need to push very actively towards promulgating the importance of special needs of children and special requirements of children's care and special information that's needed to treat them effectively. So I really think it would be unfortunate if we retrogressed from where we are at the present time, with regard to having people who have a real interest and understanding in children be responsible for their care.

DR. PODOLSKY: There used to be obstetricians and pediatricians. Then we had pediatricians and pediatric cardiologists, and then neonatologists. Now I hear talk that there is need for further specialization, I suppose pediatric fetologists or fetal medicine. Will you expand on that, Dr. Rudolph?

DR. RUDOLPH: I think what I said earlier addresses this issue, and that is that it's not possible with the wealth of knowledge and information that we've gained over the last number of years for anybody to become a real expert in the whole of medicine. So the result is that as we begin to develop more and more areas, which are highly specialized, it becomes impossible for somebody who has a broad background to be able to become an expert in the specialized field. Now obviously somebody could take on that particular interest and get to be an expert in it; but, I think it's true that as advances are made, there will be more and more areas which require special knowledge and special techniques. Because of this, I think we have to develop those if we want to advance our treatment and management of these special problems. Now, I think one of the difficulties is that what's happened in the past, and still occurs, is that there is the tendency to expect that if this special area develops in one institution, then every institution has to have it. And that I think has been our greatest mistake. I think what we really need to do for these very highly specialized areas is to develop centers of excellence. If we do that, I think it would be economically viable, and it would not create an excess of individuals trained in these special areas.

I think the biggest problem we've had, for example, in pediatric cardiology, is I

think we developed too many pediatric cardiologists for awhile. And I think that, unfortunately, what has happened is that pediatric cardiologists, because of the need for material, have created an atmosphere where pediatricians are scared of any child who has a murmur. What has developed, I think, is that pediatricians are no longer willing to make any decisions about a child who has any suggestion of a cardiac problem. This is one of the things, incidentally, that I feel is terribly important in teaching residents. I really feel that we have to make residents comfortable with making decisions about clinical examination of children with murmurs. But I think what's happened now is that most pediatricians are not willing to take responsibility for making a decision about a child with a murmur. And the result is that pediatric cardiologists are devoting a good deal of their time and effort to assessing children with non-significant murmurs. Now, I don't understand quite how this philosophy develops, but it certainly develops in most areas that people begin to relinquish their responsibilities in making decisions. Now I've always felt that in teaching medical students and residents cardiology, we should not be teaching them complex lesions. We should be educating them about how to clinically evaluate a child with a murmur, or with respiratory distress. We shouldn't inculcate in them the idea, "Well, don't you bother with it if the child has a murmur; send it to a cardiologist." I think that's wrong, and I think that's happened in many fields.

I'd like to get back to the question though, that you had raised about what we might call ultra-specialization, and the fact that we might need people who are expert in fetal-physiology or fetal surgeons, for example. I don't see that this is something that is completely out of line if we think about where we're going. You know, the situation is like the one you mentioned, the example of obstetricians and neonatologists. Obstetricians in general do not understand fetal physiology; they're much more concerned with the maternal aspects. Neonatologists also don't understand fetal physiology; they understand something that happens after birth. So that there is this area where special training and special understanding is necessary. This is a good example of where the understanding of mechanisms, of basic physiological mechanisms, of how the fetus behaves physiologically, is so crucial if one wants to get into an area of treating a fetus. So that, sure, I think that this would be an area of ultra-specialization if we feel, philosophically and ethically, that this is something we should be doing. And that, of course, is the bottom line. Do we feel that this is something that should be done? Now, there are many issues relating to that. But if we decide that that's where we are going, then I think we need somebody who is going to be specially trained. Because neither of the other two groups have a detailed enough understanding to be able to cope with the problems that arise.

I can tell you that I've seen a good example of this. Surgeons, general pediatric surgeons, have been very interested in fetal surgery at UCSF. And they've been interested in doing some work on treating diaphragmatic hernia before birth, operating and curing and correcting diaphragmatic hernia before birth. In the process of doing this, the mortality has been fairly high, and the reasons for the fact that the fetuses were dying after surgery was not fully understood. I was called in to consult with them about what may be happening, and we did some very simple studies based on work I'd done previously regarding the course of the umbilical circulation in the liver, which clearly explained why they were getting into trouble. Now it took somebody who had an understanding of the physiology to be able to recognize what the problem was. So I think you do need special education, special understanding and training to have new approaches. And I think we'll always have that. But I think the important issue, which I really would like to reiterate again, is that I don't feel that everybody should be doing it. I think that there should be a limited and restricted number of centers where these complex procedures are done.

DR. PODOLSKY: Dr. Rudolph, you've served on many councils, committees, and organizations throughout your tremendous career. Where do you think you've left your imprint or had the most impact?

DR. RUDOLPH: Well, to respond to that I think I should firstly talk a little bit about serving on committees in the earlier part of my career, and that is on the National Institutes of Health Cardiovascular Study Section. To me, that was one of the most demanding but also satisfying contributions that I made. Firstly, it required an enormous amount of effort to make a rational decision about whether a research proposal was worth supporting or not. But I think that in terms of the contributions I made there, I again felt that I did have some impact in trying to get people on the committee to be fair and consider really every aspect of a proposal. And I felt very satisfied about the fact that I thought that I was able to influence people in their decisions.

Now, subsequently, in terms of editorial board activities, it's sort of interesting that almost always the work that is most demanding also tends to be the most satisfying. The most demanding aspect of all editorial board work that I've been involved with was at a time when I was an associate editor to Julius Comroe for *Circulation Research*. And we were editors of this journal for about five years, and during that time I think that we had a tremendous impact, not only on the quality of the journal, but on the support we gave to authors. I learned a great deal from Julius Comroe during that period. I think one of the important things that I learned, and which we were able to really put in practice, was that we never made a decision regarding a manuscript without providing

detailed information to the authors. We never made a decision to reject a paper without really providing detailed reasons for rejection or modification. In addition, when we asked an author to modify a manuscript, we gave them really detailed information about what we expected them to do. So I know that when I worked as associate editor for *Circulation Research*, I was working every night and every weekend; but it was, at the same time, an extremely satisfying experience because I really felt I was making a contribution and giving advice to the authors which was really valuable to them.

Another area where I really felt that I made an important contribution was when I was on the council of the American Pediatric Society. At the time I became a member of the council, there was a great deal of conflict between the American Pediatric Society and the Society for Pediatric Research. The Society for Pediatric Research is the organization which includes younger people in research, and by the time one becomes 45 years old one becomes an emeritus member of this society. Now for some reason that I'm not quite sure of, over the years what had developed was a conflict between these two groups. So there were always separate meetings; there was never any real coming together of the two groups except at the national conference held every spring. I always felt concerned about the fact that there was this separation and conflict, so I set out to try to bring the two groups together. And I believe that I was, in large part, responsible for the fact that the two organizations now work extremely closely together, and I felt it was important for pediatrics in general to have the groups working harmoniously rather than in conflict. And I think that that has developed now, to the point where the programs that are developed for the annual meeting are jointly developed by the two groups. It's really a very excellent relationship that has been developed between these groups, and I feel very satisfied about the fact that this has come about.

DR. PODOLSKY: Where do you think pediatrics will go in the next ten years, next 50 years? Do you think that pediatricians entering pediatrics today can have as worthwhile a career as you have had?

DR. RUDOLPH: Well, that's a tough question. I have no idea where pediatrics is going to be in the future. I really don't think that there's going to be any dramatic change within the next ten years, although we do have the pressures with the changes in delivery of health care. But I don't think that in the relatively immediate future that it's going to have any major impact on the way in which pediatrics is practiced at the moment, except insofar as the economic aspects of it. I think that there has to be, with the development of the health maintenance organization system, some reorientation in the ways in which insurance companies relate to pediatricians. Obviously, there's going to be less freedom of choice of pediatrician by families. (Just as an aside, I find it

really quite surprising that the majority of the population is willing to accept this. There doesn't seem to be any outcry about the fact that choice is being severely restricted with the development of the managed care arrangements.) But I do think that this will be the major change that occurs within the next ten years. I don't believe that the practice of pediatrics will change dramatically otherwise. I think it's going to be more difficult for the pediatrician to practice in the way in which they have been now, because there will be some restrictions placed on their freedom to practice in any way they please.

Now when we get to the question of what's going to happen within 50 years, I really don't have any good ideas about that. I would like to believe, though, that with what is occurring at the present time in the managed care environment, that eventually people will become so disgruntled with the control that insurance companies have over their lives, that there will be major objections to the whole system. I imagine that the result of this will be that people will push more and more for a comprehensive health care system, which is run by the country through the federal government. Because I think that although people have not complained much now, I think they will begin to complain eventually as they find how much their choice is restricted, and how much limitation there is on what can be performed on people in regard to their health.

How pediatrics specifically will fare if that develops, again, I'm not sure. But I think that it will probably be a lot more comfortable to practice in that sort of environment than it is currently, or will be currently with the managed care arrangements we have now with the control by the insurance companies. I think also we will find that there will begin to be increasing limitation of the number of programs that are permitted. I think that if we do have some state or federal control, that we will find that the ability to set up highly specialized pediatric programs, at will, will be severely restricted. I think, increasingly, we will find that the center development becomes more and more prevalent. And we'll find that there will be centers which are established in key geographic areas, and that people will have to be prepared to move for their medical care to get it at these specialized centers. I don't think we can afford to have specialized programs in every community hospital or even every academic institution.

I think that's been one of the biggest problems that we've had in the past, and which has really also resulted in a tremendous cost, and that is the idea that we have highly specialized centers. There have been numerous studies which have been done to show that, economically, the cost of care, and I'm talking about highly specialized programs, is very dependent on the number of patients being handled in any program. So that where we have small programs, doing

relatively few procedures or handling relatively small number of complex cases, the cost is going to be extraordinarily high. And, these costs can be remarkably reduced if we have a much more efficient system where there's a congregation of specialized problems.

The final words I would say is that really I've enjoyed doing this. It's made me think back to my past; it's made me think somewhat about the future. I've thought about the future but this has sort of made me pinpoint my thoughts. So I've enjoyed doing this and I appreciate the opportunity to have been asked to do this. It's great.

DR. PODOLSKY: Thank you, Dr. Rudolph. This concludes the interview. There are two tapes. Dr. M.L. Podolsky, interviewer of Dr. Abraham Rudolph, on Friday, August 30th, 1996. End of dictation. Thank you.

END OF TAPE

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University of California, San Francisco
CURRICULUM VITAE

Name ABRAHAM MORRIS RUDOLPH

Current Titles Professor Emeritus of Pediatrics
Senior Staff, Cardiovascular Research Institute

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Education

1946	University of the Witwatersrand, Johannesburg, South Africa	M.B.B.Ch. (Summa cum laude)
1951	University of the Witwatersrand, Johannesburg	M.D.
1946-47	Johannesburg General Hospital	House Physician, House Surgeon
1947-48	Transvaal Memorial Hospital for Children	House Physician
1948-49	Transvaal Memorial Hospital	Casualty and Outpatient Officer
1949-51	University of the Witwatersrand and Transvaal Memorial Hospital for Children	Pediatric Registrar
1951-53	Harvard Medical School, Boston, MA	Research Fellow, Pediatrics
1951-53	Children Hospital Medical Center, Boston, MA	Fellow in Medicine
1953-55	Harvard Medical School	Research Associate, Physiology

Licenses

Massachusetts, Ohio, New York, California

Certifications

1949	M.R.C.P., Royal College of Physicians of London
1949	M.R.C.P.E., Royal College of Physicians of Edinburgh
1953	Diplomate, National Board of Medical Examiners
1953	Certified, American Board of Pediatrics
1961	Certified, Sub-Board of Pediatric Cardiology

Principal Positions

1955-57	Harvard Medical School	Instructor, Pediatrics
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1955-60	Children's Hospital, Boston, MA	Assoc. Cardiologist in charge of Cardiopulmonary Laboratory
1957-60	Harvard Medical School	Associate, Pediatrics
1960-66	Albert Einstein College of Medicine, New York, NY	Director, Division of Pediatric Cardiology
1960-62	Albert Einstein College of Medicine	Assoc. Professor, Pediatrics
1962-66	Albert Einstein College of Medicine	Professor, Pediatrics and Physiology
1966-94	University of California, San Francisco	Professor, Pediatrics
1966-94	University of California, San Francisco	Chief, Division of Pediatric Cardiology
1966-	University of California, San Francisco	Senior Staff Member, CVRI
1970-86	University of California, San Francisco	Vice-Chairman, Dept. of Pediatrics
1974-88	University of California, San Francisco	Professor, Physiology
1974-94	University of California, San Francisco	Neider Professor, Pediatric Cardiology
1974-94	University of California, San Francisco	Professor, Obstetrics, Gynecology and Reprod. Sci.
1986-91	University of California, San Francisco	Chairman, Dept. of Pediatrics
1986-91	University of California, San Francisco	Director, Pediatric Services
1994	University of California, San Francisco	Professor Emeritus, Pediatrics

Awards and Honors

1940-44	Reyersbach Scholar: University of the Witwatersrand
1941	Prize for Best Performance in Anatomy: University of the Witwatersrand
1942	Prize for Best Performance in Pathology and Bacteriology: University of the Witwatersrand
1943	Prize for Best Performance in Pharmacology: University of the Witwatersrand
1945	Prize for Best Performance in Medicine: South African Medical Graduate Association
1945	Bronze Medal for Most Distinguished Graduate: South African Association
1958-62	Established Investigator of the American Heart Association
1962	Distinguished Achievement Award: Westchester Chapter, American Heart Association

- 1964 E. Mead Johnson Award for Research in Pediatrics: American Academy of Pediatrics
- 1965 F.R.C.P., Edinburgh
- 1965 Alpha Omega Alpha (AOA) Society
- 1965 Research Award, Young Men's Division: Albert Einstein College of Medicine
- 1962-66 Career Scientist: Health Research Council of the City of New York
- 1973 Invited as one of seven visiting Cardiologists: Chinese Medical Association
- 1978 Faculty Research Lecturer: University of California, San Francisco
- 1979 Borden Research Award: American Academy of Pediatrics
- 1984 Selected as one of 120 best doctors in USA by Good Housekeeping
- 1984 Selected to contribute to The Roots of Perinatal Medicine (major contributors to advances in field in past 25 years)
- 1985 F.R.C.P., London
- 1986 Merit Award: National Heart, Lung and Blood Institute
- 1987 Elected to Institute of Medicine of the National Academy of Sciences
- 1987 Arvo Yllpo Medal (given every five years for contributions in Pediatrics, one to a Finnish Pediatrician, one to an International Pediatrician): Helsinki University, Finland
- 1991 Research Achievement Award, American Heart Association
- 1991 Faculty Teaching Award, University of California, San Francisco, Department of Pediatrics
- 1992 J.H.P. Jonxis Medal, Children's Hospital of the University of Groningen, The Netherlands, First Awardee, May, 1992
- 1992 Lifetime Achievement in Teaching Award, American Academy of Pediatrics
- 1993 Joseph W. St. Geme, Jr., Leadership Award, Ambulatory Pediatric Association, American Academy of Pediatrics, American Board of Pediatrics, American Pediatric Society, Association of Medical School Pediatric Department Chairmen, Association of Pediatric Program Directors, Society for Pediatric Research

Professional Organizations

Memberships

American Academy of Pediatrics
 American Pediatric Society
 Society for Pediatric Research
 Western Society for Pediatric Research
 Society for Clinical Investigation
 Western Society of Physicians
 American Physiological Society
 American Federation for Clinical Research
 Institute of Medicine, National Academy of Sciences

Honorary Memberships

Cardiac Society of Australia and New Zealand

European Association of Pediatric Cardiologists
 Italian Cardiac Society
 Society for Gynecologic Investigation
 Swiss Pediatric Society
 Finnish Perinatal Society
 Italian Society of Perinatal Medicine

Professional Activity

National Institutes of Health Appointments

1961-65	National Institutes of Health	Cardiovascular Study Section
1966	National Institutes of Health	Heart Training Committee
1968-72	National Institutes of Health	National Advisory Heart Council

Professional Organization Activities

1961-64	Society for Pediatric Research	Council Member
1962-65	American Academy of Pediatrics	Executive Committee, Section on Cardiology (Chairman, 1965)
1965-66	New York Heart Association	Board of Directors
1966	California Heart Association	Scientific Subcommittee
1966-72	American Board of Pediatrics	Sub-Specialty Board of Pediatric Cardiology (Chairman 1971-72)
1977-80	American Heart Association	Publications Committee
1978-79	American Heart Association	Research Study Committee
1985-	American Pediatric Society	Council member
1992	American Pediatric Society	President Elect
1993	American Pediatric Society	President

Service to Professional Publications

1964-70	<i>Pediatrics</i>	Editorial Board
1964-66	<i>Investigative Radiography</i>	Consulting Editor
1965-70	<i>Circulation Research</i>	Associate Editor
1966-75	<i>Circulation</i>	Editorial Board
1967-	<i>Advances in Pediatrics</i>	Associate Editor
1970-77	<i>Pediatric Research</i>	American Associate Editor
1979-	<i>Pediatric Cardiology</i>	Editorial Board
1979-	<i>Clinical Pediatrics</i>	Editorial Board
1980-87	<i>Journal of Developmental Physiology</i>	Editorial Board
1983-	<i>Biology of the Neonate</i>	Editorial Board
1983-	<i>Circulation</i>	Editorial Board

Other Professional Service

1965-67	Department of Health, City of New	Cardiac Advisory Committee
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1981	York State of California	Cardiac Care Task Force (Chairman, Subcommittee on Congenital Heart Disease)
1981	California State Legislature	Committee on Cardiac Care-- Hearing April 16
1985	National Heart, Lung, and Blood Institute	Chairman: Review Committee for FFA, "Protection of the Immature Myocardium," June; Chairman: Special Committee for Grant Review, September
1989	International Union of Physiological Sciences	Commission on Foetal and Neonatal Physiology

Distinguished Lectureships (since 1980)

1980	Pfizer Lecturer in Clinical Pharmacology, Minneapolis, MN Distinguished Speaker, Silver Anniversary Celebration, Albert Einstein College of Medicine, New York, NY
1981	Centennial of University of Nebraska College, Omaha, April 1 (Invited Speaker)
1982	Ashley Weech Visiting Professor, Children's Hospital, Cincinnati, OH
1983	Stanley Wright Research Lecture, Western Society for Pediatric Research, Carmel, CA Helen B. Taussig Lecture, American Heart Association, Anaheim, CA Keynote Speaker, International Symposium on Sheep Physiology and the Development of the Cardio-respiratory System, Melbourne, Australia
1984	Harvey Lecturer, Physiological Development of the Fetus and Newborn, Oxford
1985	Keynote Speaker, John Lind Memorial Symposium on Developmental Physiology of the Heart, Lungs and Circulation in the Fetus and Newborn, Paris, France Liebman Visiting Professor, Rainbow Babies and Children's Hospital, Case-Western Reserve School of Medicine, Cleveland, OH Inaugural Lecturer, First National Congress of Italian Society of Perinatal Medicine, Salsomaggiore, Italy
1987	Alton Goldbloom Lecturer, Montreal Children's Hospital, Quebec, May 6-8 Arvo Yllpo Lecturer, University of Helsinki, Finland, Oct. 26-27
1988	Ben Kagen Lecture, Cedars Sinai Hospital, Los Angeles, CA Henry Barnett Lecturer, Albert Einstein College of Medicine, New York, Sept. 29
1989	Russell Blattner Lecturer, Baylor/Texas Children's Hospital, Houston, TX Moll Lecture, University of Washington, Seattle

- John Keith Lecture, Canadian Cardiovascular Society, Vancouver, British Columbia
- 1990 Clausen Lecture, State University of New York, Rochester
- 1991 University Hospital, Munich, Germany, May 2-4
 Children's Hospital, Dallas, TX, June 6, 7
 First International Congress of Perinatology, Invited Speaker, Tokyo, Japan, November 4-9
 International Fetal Cardiology Symposium, Invited Speaker, Rome, Italy, November 23-27
 A. Graeme Mitchell Visiting Professor of Pediatrics, Children's Hospital Medical Center, Cincinnati, OH
- 1992 University of Georgia, Augusta, GA, April 27-29
 Rijks-University, Groningen, The Netherlands, May 17-23
 Inaugural Speaker, Arnold H. Einhorn, M.D. Lectureship in Pediatrics, Children's National Medical Center, Washington, D.C., May, 1992
 Dr. Jerome D. Solomon Memorial Lecture, The National Center for Advanced Medical Education, Chicago, IL, June, 1992
 Inaugural Norman S. Talner Lecture, Yale University, New Haven, CT, Sept. 11-14
 California Society of Pediatric Cardiology, Lecture, Sept. 19
 Founders' Award Lecture, American Academy of Pediatrics, Section on Cardiology, Oct. 11
- 1994 Celebrating 125 Years of Contributions to Pediatrics, Invited Lecture, Children's Hospital, Boston, June 10, 11

Scientific and Professional Meetings and Workshops (1980 to present)

International

- International Course in Angio-hemodynamics in Congenital Heart Disease, Madrid, Spain, May 21-22, 1981 (Keynote Speaker)
- Theory of Cardiovascular Disease, Hamburg, FR Germany, June 26-27, 1981 (Invited Speaker)
- International Congress of Pediatric Cardiology and Cardiac Surgery, Vicenza, Italy, Sept. 28-Oct. 1, 1981 (Invited Speaker)
- First International Symposium on Fetal Echocardiography, Strasbourg, France, April 23-24, 1982 (Invited Speaker)
- International Symposium on Pulmonary Arterial Hypertension, Frunze, USSR, June 28-30, 1982 (Invited Speaker)
- Sigrid Juselius Symposium, Helsinki, Finland, August 9-13, 1982 (Invited Participant)
- 29th International Congress, International Union of Physiological Sciences, Sydney, Australia, 1983 (Chairman, Symposium—Birth: The transition)
- International Workshop on Patent Ductus Arteriosus, Heidelberg, FR Germany, April 28-29, 1983 (Invited Speaker)
- International Symposium on Perinatal Medicine, Pamplona, Spain, May 30-June 2, 1983 (Invited Speaker)

Alfred Benson Symposium Cardiovascular Shunts, Copenhagen, Denmark, June 17-21, 1984 (Invited Participant)

Recent Advances in Perinatal Medicine, Ettore Majoravia Center for Scientific Culture, Erice, Sicily, Dec. 6-13, 1984 (Invited Participant)

Symposium on Hypertensive Disease in Pregnancy, Gubbio, Italy, Dec. 24, 1984 (Invited Speaker)

Second World Congress of Pediatric Cardiology, New York, June 1985 (International Committee)

10th Nordic Congress in Perinatal Medicine, Turku, Finland, Aug. 28-30, 1985 (Invited Lecturer)

Dutch Pediatric Association Annual Congress, Pediatric Cardiology Section, Groningen, The Netherlands, Oct. 24-26, 1985 (Invited Lecturer)

Symposium on "New Horizons in Children's Heart Disease," Toronto, Canada, May 28-30, 1986 (Invited Lecturer)

European Society for Pediatric Research Annual Meeting, Groningen, The Netherlands, Sept. 7-10, 1986 (Chairman—Nutrition and Metabolism), Invited Speaker—Fetal and Neonatal Metabolism

National Child Health Research Foundation, Paediatric Society of New Zealand Annual Meeting, Auckland, Nov. 16-21, 1986 (Visiting Lecturer)

Symposium on Congenital Cardiac Malformations, University of Kent, Canterbury, England, April 13-15, 1987 (Invited Lecturer)

First International Symposium on Intrapartum Biochemical Monitoring of the Fetus, Atlantic City, NJ, June 1-3, 1987 (Invited Lecturer)

Endocrine Control of the Fetus, International Symposium, Giessen, West Germany, July 29-31, 1987 (Invited Speaker)

International Symposium for Fetal and Neonatal Development, Oxford, England, Aug. 2-7, 1987 (Invited Lecturer)

Controversial Issues in Neonatal Interventions, International Workshop for Neonatologists, Zurich, Switzerland, Oct. 1-2, 1987 (Invited Lecturer)

5th Asia Oceanic Congress of Perinatology, July 7-9, 1988

International Symposium on Perinatal Hypertension, Perugia, Italy, March 30-31, 1989 (Invited Speaker)

Recent Advances in Perinatal Medicine, Erice, Italy, April 3-4, 1989 (Keynote Speaker)

XXXI International Congress of Physiological Sciences, Helsinki, Finland, July 9-14, 1989

Fetal Cardiac Symposium, Ancienne Faculte de Medecine, Paris, France, Sept. 10-12, 1989 (Intl. Organizing and Scientific Committee, Keynote Speaker)

Symposium on Transposition, Munich, Germany, May 3-4, 1991 (Invited Lecturer)

International Perinatal Society, Tokyo, Japan, Nov. 4-8, 1991 (Invited Lecturer)

International Fetal Cardiology Symposium, Rome, Nov. 24-27, 1991 (Invited Lecturer)

World Congress of Pediatric Cardiology, Paris, June 21-25, 1993 (Invited Lecturer)

National

Maurice Kay Pediatric Symposium, Providence, RI, Nov. 3, 1982 (Invited Speaker)
American College of Cardiology, March 1984 (Program Chairman, Mini-Course Cardioactive Drugs in Children)
Fetal Medicine and Surgery Society, Washington, DC, June 9, 1984 (Invited Lecturer)
Conference on Drug Exposure and Effects on the Fetus, National Institute on Drug Abuse, Bethesda, MD, Sept. 24-25, 1984 (Invited Participant)
Cardiovascular Ultrasonic Flowmetry Symposium, Albuquerque, NM, Feb. 14, 1985 (Invited Speaker)
National Kaiser Permanente Pediatric Conference, Maui, HI, June 22-29, 1985 (Invited Speaker)
NIH Pediatric Cardiology Workshop, Washington, DC, Sept. 22-24, 1985 (Invited Participant)
Ninth Annual Conference on Management of the Tiny Baby, Orlando, FL, Feb. 18-20, 1987 (Invited Lecturer)
Association of Medical School Pediatric Department Chairman (AMSPDC), 1987-89
American Academy of Pediatrics Annual Meeting, 1987, 1988 (Invited Speaker), 1989 (Invited Speaker)
American Pediatric Society/Society for Pediatric Research, annually since 1966
Society for the Study of Fetal Physiology, July 12-16, 1988 (Invited Speaker)
Liggins Symposium, Rotorua, New Zealand, July 24-28, 1988 (Invited Speaker)
Seventh Conference on Apnea of Infancy, Palm Springs, Jan. 26-28, 1989 (Invited Speaker)
Kaiser Permanente Symposium in Perinatology, Long Beach, CA, May 25, 1989
NIDA Technical Review, Membranes and Barriers, Bethesda, MD, Sept. 28-29, 1993 (Invited Lecturer)

Regional

Western Society for Pediatric Research, annually since 1966

Invited Papers, Lectures, Presentations (1980 to present)

March 31, 1982	Pediatric Day, Albany Medical College, Albany, NY (Keynote Speaker)
May 15, 1982	Henry L. Barnett Day, Albert Einstein College of Medicine, New York, NY (Invited Speaker)
May 8-30, 1983	University of Groningen, The Netherlands (Visiting Professor)
Feb. 8-9, 1984	Hospital Sainte-Justine, Montreal, Canada (Invited Lecturer)
May 3, 1984	Course in Pediatric Intensive Care, Harvard Medical School, Boston, MA (Invited Lecturer)
May 21-23, 1984	Pediatric Cardiology 1984, Rome, Italy (Invited Lecturer)
April 17, 1985	Department of Physiology, Stanford University, Palo Alto,

	CA (Invited Lecturer)
April 19, 1985	American College of Osteopathic Pediatricians, Lake Tahoe, CA (Invited Speaker)
May 20-21, 1985	Department of Physiology, University of Florida School of Medicine, Gainesville, FL (Visiting Professor)
June 4-6, 1987	Schneider Children's Hospital, New Hyde Park, NY (Visiting Professor)
Oct., 1987	Children's Hospital, Turku, Finland (Visiting Lecturer)
Oct. 24-25, 1987	Children's Hospital, Helsinki, Finland (Visiting Lecturer)
Dec. 1-2, 1987	Albert Einstein College of Medicine, New York, NY (Henry Barnett Lecturer)
March 20, 1988	Children's Hospital, Seattle, WA (Visiting Lecturer)
March 23-24, 1988	Children's Hospital, Winnipeg, Canada (Visiting Professor)
Nov. 8-9, 1988	Children's Hospital, Cincinnati, OH (Visiting Professor)
Jan. 26-28, 1989	Seventh Conference on Apnea of Infancy, Annenberg Center for Health Sciences, Eisenhower Medical Center, Rancho Mirage, CA (Invited Lecturer)
March 20, 1989	Children's Hospital Medical Center, Washington, DC (Grand Rounds, guest speaker)
May 25, 1989	Neonatal Symposium Kaiser Permanente, Long Beach, CA (Invited Lecturer)
June 1-3, 1989	Neonatal Medicine Symposium, Liege, Belgium (Keynote Lecturer)
July 6-8, 1989	Satellite Symposium, Fetal and Neonatal Physiology, Karolinska Institute, Stockholm, Sweden (Invited Lecturer)
July 9-14, 1989	XXXI International Congress of Physiological Sciences, Helsinki, Finland (Invited Lecturer)
Sept. 10-12, 1989	Fetal Cardiac Symposium, French Society of Cardiologyk Paris, France (Invited Lecturer)
Oct. 21-26, 1989	Annual Meeting, American Academy of Pediatrics, Chicago, IL (Invited Lecturer)
Oct. 27, 1989	Canadian Cardiovascular Society, Vancouver, BC (John Keith Lecture)
Nov. 16, 1989	175 th Anniversary, Dept. of Obstetrics and Gynecology, Justus-Liebig-Universität Giessen, Giessen, West Germany (Invited Lecturer)
Nov. 26-Dec. 1, 1989	Third World Congress of Pediatric Cardiology, Bangkok, Thailand (International Committee, Invited Lecturer)
Feb. 2-3, 1990	Third Italian Postgraduate Course on Doppler Technologies in Obstetrics, Milan, Italy (Invited Lecturer)
Aug. 11-18, 1990	Eighth Annual Kaiser Permanente Combined Pediatrics and Obstetrics-Gynecology Conference, Maui, HI (Invited Lecturer)
Oct. 7-11, 1990	VII World Congress of the International Society for the

	Study of Hypertension in Pregnancy, Perugia, Italy (Invited Lecturer)
May 4-5, 1991	Symposium to honor Dr. William Rashkind, Munich, West Germany (Invited Lecturer)
May 10, 1991	University Hospital, Siena, Italy (Invited Lecturer)
June 6, 1991	Distinguished Guest Lecturer Series, Children's Medical Center, Dallas, TX (Inaugural Speaker)
April 27-29, 1992	University of Augusta, Georgia (Visiting Professor)
May 18-22, 1992	University Hospital, Groningen, The Netherlands (Visiting Professor)
Jan. 22-23, 1993	Julius Maximilian University, Wurzburg, Germany— Symposium: Oxygen Supply to the Fetus during Pregnancy and Delivery (Invited Speaker)
Nov. 18, 1993	Kinderspital, Zurich, Symposium (Invited Speaker)

University Service

Multi-Campus

1972-73 Chancellor's Advisory Committee of Medical Education

University of California, San Francisco

School of Medicine

1966-	Ad Hoc Review Committees, Academic Senate
1966-	Ad Hoc Promotions/Appointment Committees
1966-92	CVRI Research and Education Foundation
1982	Committee on Academic Personnel (Chairman)
1982	Dean, School of Medicine Search Committee
1982-84	Committee on Committee
1983-84	Clinical Reviews Implementation Committee
1982-87	Chancellor's Panel on University-Industry Relations (Chairman 1982- 92)
1987-91	Dean's Executive Committee
1989-91	Molecular Medicine Committee

Department of Pediatrics

1970-86	Appointments and Promotions Committee (Chairman)
1980-91	Housestaff Affairs Committee (Chairman)
1982-91	Executive Committee
1986-91	Intern Selection Committee
1991-	Appointments and Promotions Committee

Hospital Committees

1986-91	Professional Services Committee
1986-91	Executive Medical Board
1988-91	Clinical Practice Organization (CPO) Board of Directors

- Executive Committee (1989-91)
1988-91 Primary Care Committee
1989-91 Ambulatory Care Committee

Teaching

- 1) Pediatric Cardiology Conference; once weekly, 1 hr.
- 2) Department of Pediatrics, morning report; twice weekly, 1 hr.
- 3) Cardiology Rounds on Neonatal Service; once weekly, 1 hr.
- 4) Informal teaching of Fellows working in my research laboratories and review of data; 1-2 hrs. weekly
- 5) Training Fellows in research procedures; 2-3 hr. weekly

Professional Activities (past 3 years)

After leaving the position of Chairman of the Department of Pediatrics in 1991, I continued to serve as Director of Pediatric Cardiology until June 1994. For 1 year, 9 months of this period, I was on Sabbatical leave in Residence.

- A. During this period I continued to contribute to Clinical Pediatrics and Clinical Pediatric Cardiology
 1. I attended in General Pediatrics in the Moffitt-Long wards for 1 month per year.
 2. I held a Pediatric Cardiology Clinic once a week.
 3. I initiated the Pediatric Cardiology Clinic in our Santa Rosa facility and first held in one half-day a month, but now two full days per month.
 4. I have provided consultation to Pediatric Cardiology Faculty on complex cardiac patients.
- B. I am the Principal Investigator of an NIH RO1 Research Grant for 50% effort. This grant is concerned with study of cardiovascular and metabolic changes associated with birth, and is being conducted in sheep. The details of my Research activities are outlined below.
- C. Service to the University includes: continuing to serve on the Chancellor's Panel for University-Industry Relations service on ad hoc committees for Academic Promotion and Appointment, Chair of Search Committee for Pediatric Electrophysiologist, membership on Pediatric Advisory Council.
- D. Research. My research studies center around study of various aspects of adaptations to birth. These studies are being conducted in fetal and neonatal lambs. Currently, the two major projects are:

1. *Chemoreflex regulation in the fetus and newborn.*

In my laboratory, we have shown that the peripheral arterial chemoreceptors are very sensitive, and that previous concepts that they were not developed were probably related to the study fetuses under anesthesia. Injection

of NaCN in very small amounts produces an active chemoreceptor response. We have also shown that in the fetus, the carotid chemoreceptor is by far the most important receptor for sensing changes in oxygen concentration. We have also developed a method for quantitating chemoreflex sensitivity by statistically examining heart rate response to magnitude of changes in arterial oxygen saturation.

An important mechanism by which chemoreflex stimulation produces its effects is by stimulating adrenal catecholamine release. We have shown that in the absence of chemoreceptors, catecholamine concentrations increase linearly with the fall in oxygen saturation in the fetus. With intact chemoreceptors, catecholamine concentrations increase exponentially as oxygen saturation is reduced.

I am now examining the changes in chemoreceptor function associated with the marked increase in arterial oxygen saturation that develops after birth. Also, the time course for chemoreceptor adaptation to its new environment and the mechanisms involved in this adaptation are being explored.

2. Role of nitric oxide and prostaglandins in cerebral vascular changes in the perinatal period.

I have developed a model in which various aspects of the birth process can be studied individually in fetal lambs in utero. We have shown that cerebral blood flow is not altered by ventilation or umbilical cord occlusion, but is markedly reduced with the increase of arterial PO₂ to postnatal levels. Currently, we have been exploring the possible role of NO and prostaglandins in this response. We have demonstrated that in the resting state, nitric oxide is acting to maintain some degree of vasodilatation. Also, it is important in contributing to the increase in cerebral blood flow associated with fetal hypoxemia. We considered the hypothesis that the reduction in cerebral blood flow associated with oxygenation could be due to blocking of NO release. Preliminary studies did not, however, show a significant role of prostaglandin release, nor of nitric oxide mechanisms, in the reduction of cerebral blood flow with increased PO₂. I propose to examine the possible role of oxygen-sensitive K⁺ channels in the responses of the cerebral circulation to changes in PO₂.

Bibliography

Manuscripts in Peer-Reviewed Journals

1. Lannon J, Rudolph AM: "Axillary-subclavian vein" compression in the costoclavicular interval. *S Afr Med J* 21:441-447, 1947.
2. Rudolph AM, Braudo JL: Amoeba of the large bowel with review of the literature. *Clin Proc* 6:287-291, 1947.
3. Nadas AS, Rudolph AM, Reinhold JDL: The use of digitalis in infants and children. *N Engl J Med* 248:98-105, 1953.
4. Rudolph AM, Nadas AS, Borges WH: Hematologic adjustments to cyanotic congenital heart disease. *Pediatrics* 11:454-464, 1953.

5. Nadas AS, Rosenbaum HD, Wittenborg MH, Rudolph AM: Tetralogy of Fallot with unilateral pulmonary atresia. *Circulation* 8:328-336, 1953.
6. Barger AC, Rudolph AM, Yates FE: Observations on the pathogenesis of congestive failure. *Bull NE Med Center XVI*: 24-29, 1954.
7. Barger AC, Rudolph AM, Yates FE: Sodium retention in heart disease. *Mod Concepts Cardiovasc Dis* 23:226-227, 1954.
8. Rudolph AM, Nadas AS, Goodale WT: Intracardiac left-to-right shunt with pulmonic stenosis. *Am Heart J* 48:808-816, 1954.
9. Cutler JG, Nadas AS, Goodale WT, Hickler RB, Rudolph AM: Pulmonary arterial hypertension with markedly increased pulmonary resistance. The pulmonary vascular obstruction syndrome. *Am J Med* 17:485-598, 1954.
10. Braudo JL, Nadas AS, Rudolph AM, Neuhauser EBD: Atrial septal defects in children. A clinical study with special emphasis on indications for operative repair. *Pediatrics* 14:618-631, 1954.
11. Heymann SC, Javett SN, Rudolph AM: Salicylate overdose and intoxication in infants and young children. *S Afr Med J* 28:1092-1099, 1954.
12. Kaye J, Rudolph AM: Retrolental fibroplasia. *S Afr Med J*, May 1955.
13. Rudolph AM, Rokaw SN, Barger AC: Chronic catheterization of the renal artery: technic for studying direct effects of substances on kidney function. *Proc Soc Exp Biol Med* 93:323-326, 1956.
14. Rudolph AM, Paul MH: Chronic catheterization of pulmonary and systemic circulations: A technic for repeated measurement of cardiac output and pulmonary and systemic pressures in the unanesthetized dog. *J Appl Physiol* 10:327-328, 1957.
15. Rudolph AM, Paul MH: Pulmonary and systemic vascular response to continuous infusion of 5-hydroxytryptamine (serotonin) in the dog. *Am J Physiol* 189:263-268, 1957.
16. Ongley PA, Nadas AS, Paul MH, Rudolph AM, Starkey GWB: Aortic stenosis in infants and children. *Pediatrics* 21:207-221, 1958.
17. Rudolph AM, Paul MH, Sommer LS, Nadas AS: Effects of tolazoline hydrochloride (Priscoline) on circulatory dynamics of patients with pulmonary hypertension. *Am Heart J* 55:424-432, 1958.
18. Rudolph AM, Mayer FE, Nadas AS, Gross RE: Patent ductus arteriosus. A clinical and hemodynamic study of patients in the first year of life. *Pediatrics* 22:892-904, 1958.
19. Fyler DC, Rudolph AM, Wittenborg MH, Nadas AS: Ventricular septal defect in infants and children. *Circulation* 18:833-851, 1958.
20. Rudolph AM, Cayler GG: Cardiac catheterization in infants and children. *Pediatr Clin North Am* 4:907-943, 1958.
21. Paul MH, Rudolph AM: Pulmonary valve obstruction during cardiac catheterization. *Circulation* 18:53-59, 1958.
22. Paul MH, Rudolph AM, Nadas AS: Congenital complete atrioventricular block: Problems of clinical assessment. *Circulation* 18:183-190, 1958.

23. Sasahara AA, Rudolph AM, Hoffman JIE, Hauck AJ: Ventricular fibrillation during catheterization of the right side of the heart terminated successfully by external defibrillation. *N Engl J Med* 261:26-29, 1959.
24. Rudolph AM, Kurland MD, Auld PAM, Paul MH: Effects of vasodilator drugs on normal and serotonin-constricted pulmonary vessels of the dog. *Am J Physiol* 197:617-623, 1959.
25. Nadas AS, Rudolph AM, Hoffman JIE: Pulmonary hypertension in children with systemic-pulmonary communications. *Circulation* 20:744, 1959.
26. Reynolds JL, Nadas AS, Rudolph AM, Gross RE: Critical congenital aortic stenosis with minimal electrocardiographic changes. A report in two siblings. *N Engl J Med* 262:276-282, 1960.
27. Rudolph AM, Auld PAM: Physical factors affecting normal and serotonin-constricted pulmonary vessels. *Am J Physiol* 198:864-872, 1960.
28. Auld PAM, Rudolph AM, Golinko RJ: Factors affecting bronchial collateral flow in the dog. *Am J Physiol* 198:1166-1170, 1960.
29. Sauvage LR, Rudolph AM, Gross RE: Replacement of the main pulmonary artery bifurcation by autogenous pericardium. *J Thorac Cardiovasc Surg* 40:56-60, 1960.
30. Sauvage LR, Rudolph AM, Gross RE: Experimental replacement of the aortic arch by homografts. *J Thorac Cardiovasc Surg* 40:6165, 1960.
31. Sasahara LR, Nadas AS, Rudolph AM, Wittenborg MH, Gross RE: Ventricular septal defect with patent ductus arteriosus. *Circulation* 22:254-264, 1960.
32. Hoffman JIE, Rudolph AM, Nadas AS, Gross RE: Pulmonic stenosis, ventricular septal defect, and right ventricular pressure above systemic level. *Circulation* 22:405-411, 1960.
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