Charles Townes

Interviewee: Charles Townes
Interviewer: Dr. Courtney Tollison
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Time Code

Minutes 0-5
- Introduction and discussion of Dr. Townes work with the maser and laser and the impact and effects it has had throughout the last several decades on both science and technology

Minutes 5-10
- Discussion of how Dr. Townes developed his interest in science at Furman; Furman's old campus

Minutes 10-15
- The Great Depression's impact on Charles Townes and his family; attending graduate school at Duke and then California Institute of Technology; working for Bell Telephone Laboratories during World War II as an engineer; working at Columbia University

Minutes 0-5
- Working with NASA and the Apollo program; chairing a presidential committee to work on the MX missiles under President Ronald Reagan

Minutes 5-10
- Winning the Nobel Prize; taking classes with Dr. J. Robert Oppenheimer; discussion of Furman professors and Townes' family growing up

Minutes 10-15
- Townes reflects on his days at Furman: interest in languages, playing in the band, being a member of the swim team; discussion on his major in modern languages and how he has used it in international travel; discussion on the misuse of science and its dangers; Godel's Theory of Incompleteness

Minutes 15-18
- Discussion on the similarities between faith and science

Transcript

DR. TOLLISON: Today is Friday, April 7th, 2006. My name is Courtney Tollison and I'm talking today with Dr. Charles Hard Townes, who was born in Greenville, South Carolina in 1915 [and is] a 1935 Furman graduate with a B.A. and B.S. degree: a B.A. in Modern Languages and a B.S. in physics. Of course, you have won numerous awards and prices and have many honors bestowed upon you, so I'm not going to go through the very impressive list of those. Perhaps just with the brief amount of time

that we have to talk today, we could discuss some things reflecting the nature, in terms of…you've had a very long and accomplished life. Of what accomplishment are you most proud of?

DR. TOWNES: Frankly, I feel more attached to my family. My family, my wife and four daughters and their husbands and children and so on…but outside of the family, of course my invention of the maser and laser was my biggest published accomplishment and I'm very proud of those. They've had a big impact on our science and our technology, both of them.

DR. TOLLISON: Certainly your legacy doesn't have to be [completely] professional in nature. Tell me about the unexpected effects of the maser and laser. What has surprised you?

DR. TOWNES: Well, of course one can never foresee the possibilities of the future of some new idea. I could foresee some of them, but by no means all of them. For example, I'm emotionally very….I feel a very strong emotion when somebody comes to me and tells me that the laser has saved their eyes. Detached retina are reattached with a laser very safely and easily and so…and I've never heard of a detached retina, so how could I protected it would be useful for that? That's the way much of science is. On the other hand, I could see a great many occupations. For example, communications… I was convinced it would be very important for communications all over, although many people didn't believe it initially. As a source of very concentrated power to burn and cut things, I could see that. Scientific purposes, scientific uses I could foresee perhaps best of all. By now, there have been about twelve different prizes in addition to my own that have used the maser and laser as tools and instruments to do further science and have been very important to further science for about twelve different Nobel Prizes. So it's been a very important scientific tools as well as a very important industrial tool. I would say the laser is now maybe in something late adolescence, in the sense that we see it can do great things and that it's very useful, [but] we don't know all of the future out of it. Clearly, with adolescents we know roughly what they can do, but they can do lots of things in the future. The laser will continue to be developed. Of course, the laser, as with every scientific thing, gets developed by more and more people contributing additional ideas. It grows like a tree, and that will continue.

DR. TOLLISON: What inspires you today?

DR. TOWNES: What inspires me today? Well, so many things, but I would say this universe. It's a fantastic universe in which we live, and people are fantastic. That's part of the universe, and they are fantastic. I would say that's the thing that inspires me, especially this wonderfully universe. If you think about it hard and recognize usually this: everything has to be designed, the laws of science have to be designed in particular ways for us to be here for things like this, for the marvelous things to happen. It's really very impressive.

DR. TOLLISON: You've been interviewed hundreds of times. What one question do you wish someone would ask you? If you look back on all these interviews that you've done, what--we've got to be missing the boat somewhere--would you want to be asked about? What would you prefer to talk about if you could talk about anything what would it be?

DR. TOWNES: I don't think I have an answer to that. I just don't know.

DR. TOLLISON: How would you like to be remembered?

DR. TOWNES: Well, personally I think the meaning and purpose of life is perhaps the most important thing. What is life all about and the question of ethics and so on; those are the most important things. As a person, I would like very much for people to feel that I had some real sense of purpose and ethics…and other people contributing to our civilization and improving human life. Those are the things that I consider most important.

DR. TOLLISON: You grew up here in Greenville and attended Furman University. Tell me about your developing interests in science as a child and how Furman may have fostered that?

DR. TOWNES: Well, I guess I was always interested in science as a youngster. It started…I lived on a small farm. My father was a lawyer, but he liked farming and we lived on a small farm on the edge of town. We had a nice stream there, and I looked at animals and birds and collected insects and flowers and fish in the stream and so on. I looked at the stars. Again, this universe is marvelous. I collected things so I could study them and see how they worked and what they were. That was my initial interest in science. As I went on, I enjoyed biology very much. My older brother became a very famous biologist, and he and I did biology together, but when I went to college I took my first course in physics. I liked mathematics very much I took my first course in physics when I went to college and I decided that was it because physics at that time showed much more clearly…proved and disproved things much more clearly than any of the other sciences could. I liked the ability to be sure and work out things completely with equations and decide what is right, what is most likely right, and what isn't, and physics seemed to be the most interesting, but was involved in all the sciences. Then I thought about astronomy, primarily in astrophysics. In addition to application of physics, which I appreciate, I was mostly interested in basic science, of understanding things, understanding how this universe works. I'm very interested in how people work. In biology, biology has become much more fundamental than it was when I was a youngster, and physics and biology are getting close together. That's a fascinating field, too, but I'm not working in it directly.

DR. TOLLISON: Who were some of your favorite professors here at Furman? Who were some of the people who mentored you?

DR. TOWNES: Well, Professor Hayden Cox was my physics professor. There was only one physics professor here then, and Cox was my physics professor. He was an excellent teacher. He was rigorous and careful. I could question him, and he would give me and answer and go on. I thought he was an excellent teacher.

DR. TOLLISON: Your Furman professors…I've read through some Furman magazines from the 1960s when the Nobel Prize was awarded and your Furman professors have glowing things to say about you as a student here. Did you come into college knowing that you wanted to study physics specifically?

DR. TOWNES: No, when I came into college, I thought I would probably want to do science, and probably biology because it was what I was most familiar with at that time or possibly mathematics. I thought of maybe going into ministry, but I thought I would undoubtedly go into science. I thought the ministry was just too much responsibility; I wasn't sure I could take that on. But [with] science, I could just learn about things and have a good time. So I was pretty sure I wanted to go into science, but which kind of science, I wasn't sure. I liked mathematics and I liked biology. I liked chemistry moderately well. I hadn't taken any physics until I entered college, and after that, when I took my first course I decided that was really what I wanted to do.

DR. TOLLISON: You lived at home during your Furman years, correct?

DR. TOWNES: Yes, I lived at home. I walked back and forth to Furman.

DR. TOLLISON: Tell me about the old campus, what you remember about the old campus.

DR. TOWNES: Well, it was a beautiful old campus, very nice old campus. In some sense, I was sorry to see them move because I thought it was a nice campus and they were moving to the other end of town. On the other hand, they needed a bigger campus. They moved out there, and it's a beautiful campus now.

DR. TOLLISON: How did the Great Depression affect your live specifically or what do you remember about the Great Depression affecting Furman?

DR. TOWNES: The Great Depression? Well, the Great Depression certainly affected all of our lives. My father, a lawyer, he didn't go broke but he had to be careful and we all had to be careful. As a youngster I worked hard, and I'd pick up a little money here and there and so on. I never felt that we were poor. I just knew that we had to be very careful and watch the funds carefully. When I came to Furman, I was glad to get a little bit of financial help because of…my scholarship was good, so I got a little bit of financial help. Then, when I went to graduate school I was disappointed when I couldn't get a good scholarship or any financial help at any of the big schools in the East. [Short discussion about changing recording tapes.] I applied to Princeton and Harvard and Cornell and so on. I did get some help at Duke, so I went to Duke for a

year and took a master's degree there, but Duke was not an important school in physics at that time. So I had saved up $500, which at that time was more money than it is now, and I decided that I would go to the best place I know and see if I could make it. So I went to Cal Tech (California Institute of Technology), which was the very best place. Robert Oppenheimer was teaching there and many other important people. Linus Pauling. But I went there with $500 dollars and after one semester I got a teaching assistantship and was able to continue. That was a time when money was scarce. It did affect my life some, but I think it worked out very well. I was lucky in that we made it.

DR. TOLLISON: Tell me about your involvement and the research that you conducted during World War II?

DR. TOWNES: During World War II, I [went] into engineering. I accepted a job at Bell Telephone Laboratories. After I finished my Ph.D., I really wanted to go to the university and do basic physics, but jobs were very scarce then. That was still the depression years, 1939 when I finished Cal Tech and got my Ph.D. Jobs at universities were very scarce and Bell Labs offered me a job and wanted me to come there, and my professor said, "It's a very good job. You ought to take it." I knew Bell Laboratories was an excellent place for science, so I decided to go, and they let me do physics for a short while, and then they said, "The war is coming on. We've got to do engineering. We want you do work on radar bombing systems." So I had to become an engineer. That was disappointing in a way. On the other hand, it's been very valuable to me. I learned a lot of engineering, and most of my work has been a combination of engineering and physics, which helped me invent the maser and the laser. So I worked on radar, but I knew all about dystrons and magnatrons and airplanes. I flew an airplane testing a radar system and so on. So I learned a great deal during World War II working on the practical systems, and of course…I don't like war, but I felt that we had to beat Hitler. We had to stop Hitler somehow or another, and so everybody was working on the war at that time. All the scientists and technologists were working on the war, and I felt that I didn't want to do that, but I had to and ought to, and I did. It worked out really wonderfully. After the war, Bell let me get back into physics, and I used the radar techniques to do some knew kind of physics. I used microwaves to study molecules, and that became a very important subject. It was interesting, and with my work I was invited to come to Columbia University after about three years after the war. I went to Columbia University and since then I've been at universities. Bell Laboratory let me do basic research there. They didn't think it would have any application to them, but they felt that if I really wanted to do it, they would accept that, so they supported me.

DR. TOLLISON: How did you learn how to fly an airplane?

DR. TOWNES: I said I flew in an airplane, but actually I did fly an airplane. When I went into [inaudible] and I went back and forth I felt that maybe I should learn how to fly an airplane. I took an airplane course and flew an airplane by myself once, but I decided that I'd have to practice too much to keep it up. It would really be less

time consuming to just take a commercial plane, so that's what I did. No, I wasn't flying airplanes, but I did fly a great deal in airplanes and work in airplanes while we were flying and made observations. We dropped bombs from airplanes to practice hitting things so we would know our system would work, that kind of thing.

DR. TOLLISON: This was in the Caribbean: is that were y'all did most of your work?

DR. TOWNES: Yes, largely in the Caribbean is where we dropped the bombs. We dropped the bombs on the old ships.

DR. TOLLISON: You served in an advisory role on presidential commissions. Tell me about your role during the Cold War Years and also during the years of the space race.

DR. TOWNES: Let's see. I did serve on the President's Science Advisory Committee. I was Vice Chairman of that for a few years, and I felt that it was important and I would do it. It was very interesting. Then, in addition, I advised NASA in the first landing on the moon. That happened somewhat by accident. A friend of mine had become head of the Apollo program to try to land on the moon. Many scientists were saying that it wasn't going to work, that it was much too expensive and we couldn't do it in time, but Kennedy had said and so on. In fact, the head of MIT came out saying that it wouldn't work as many scientists did. I saw this friend of mine, I ran into him on the seat, and I said," All these scientists are making public statements about it that it's not practical and that it can't be done. Well, you are working on, you should be talking with them more and seeing if they have some specific objections, and see what they are. Or otherwise, if you can disprove their objections, you should talk to them and see if you can teach them so they aren't so publically against you." Then, a week later, he called me up and said, "I'm in NASA. We'd like to get together with science, and we'd like you to form a committee." I thought, "Well, okay I ought to do it. We need to get science and NASA together more. So I formed a committee of scientists and engineers, many of who objected to the project. They didn't think it would work. I said, "Look the government is trying to do it, and they're committed to it, and we ought to see if it can be done well." And most of them except one, who said, "I've always thought that something that wasn't worth doing wasn't worth doing well, so I'm not going to help." He had that attitude toward the Apollo program. We worked with the head of the program for about a year. Many people on the committee began to be convinced that it made since after all. We met very regularly with the head of the Apollo program advising them and talking with them. When it landed…actually most unusual [was that] it was one of the only government programs that ended on time and under budget. It's amazing for the government: on time and under budget. It was a fantastic landing and it made an enormous difference to the United States internationally. It made an enormous difference to the position of the United States in comparison between us and the Soviet Union. In fact, Vannevar Bush, who was a big figure at MIT and had come out very publically against it…I was at MIT, I was posted at MIT, and he jumped on me…he was chairman of the Board of Trustees and he said," Son, that's

crazy. You shouldn't be doing this." I said, "Well, I think I ought to do it." After the landing, he called me up and said, "You know, that's a fantastic achievement." Well, I was glad he turned around completely, but he was absolutely against it, publically against it, and he beat on me because I was doing it and he thought I was crazy. Now, there are many other things I worked on. Later in life, I was chairman of a committee appointed by Reagan to decide what to do with the MX. The MX missile I wasn't very much in favor of. They were stared under Carter, and the Reagan administration wanted to know what to do with them. There were many of them to build, and I agreed to chair a committee to study it and decide what to do. Fortunately, Reagan took the advice of the minority, which I was one member of it. There were only three or four of us, and that's about all. So I talked to Reagan and the cabinet about it, and some of the cabinet, particularly the military, wanted to go ahead with them, but Reagan decided to go along with my recommendation to make a very limited number. I was very pleased about that.

DR. TOLLISON: You shared the Nobel Prize with two Russian scientists. Was there any cooperation amongst the three of you at this point in time?

DR. TOWNES: There was no cooperation before the Nobel Prize. I knew them, and they were working on microwave spectrometry as I was, so we exchanged papers and so on, but I didn't really know them very much before that. I had had some meetings with them. I met them first in England, and I didn't know that they were working on this, also. They never made one work, actually, before I had made one work and published it and they knew about it and they copied some of what I was doing. But they did have some ideas about it. They were very good scientists, and they had some good ideas about it. Because they had some original ideas themselves and some that paralleled mine to some extent, they were given the Nobel Prize, too. They were excellent scientists, and I saw a great deal of them after that.

DR. TOLLISON: Tell my about your research with Dr. Oppenheimer.

DR. TOWNES: I never did research with Oppenheimer. I was in his class. He's a theorist. I liked physical theory, but I never did any unique research in theoretical…you do some theory in papers, but primarily I'm an experimentalist. I never worked directly with him, but I took his courses for the three or four years that I was at Cal Tech. I knew him well, and I talked with him a great deal. I never did physical research with him.

DR. TOLLISON: These would be the years before he took over the Manhattan Project?

DR. TOWNES: Oh yes, that's right.

DR. TOLLISON: Did you keep in touch with him during that time?

DR. TOWNES: Yes, I saw him occasionally during that time, but not so much.

DR. TOLLISON: Did you all ever have conversation about the atomic bomb?

DR. TOWNES: Yes, I had some casual conversation, but I never [inaudible].

DR. TOLLISON: When you think back on your college years at Furman, what do you think about? What stands out most to you?

DR. TOWNES: What stands out about Furman?

DR. TOLLISON: Your college years specifically.

DR. TOWNES: Well, Furman was a small college and so I basically could know all the professors and they could know me. We had really good personal relationships and I learned a lot from them. The class was relatively small, and the professors were generally of high quality, excellent. They were not doing very much research, but they were very intelligent. I took some good philosophy and religious courses here, which that was emphasized. And then I could take modern languages, too. It was small; there was not a lot of science here. I took three courses in physics. That was about all there was. In the major, I had to take four courses, so I studied a book for the fourth course. I studied the book and worked the problems in it.

DR. TOLLISON: Did you work with Professor John Sampey, a chemistry professor here?

DR. TOWNES: Some, yes, I remember him very well.

DR. TOLLISON: What do you remember about him?

DR. TOWNES: Well, he was a very nice person, a good chemist and a very nice person, and I enjoyed him.

DR. TOLLISON: Which professor inspired you or planted the seed in your head about going to graduate school for further study of physics?

DR. TOWNES: I wouldn't it was any one professor who did that. I just always planned to do that. I always planned to go into science, and go into it deeply. I said it was Professor Cox who taught me physics the first time, but eventually physics was what I wanted to know, but then I think all the professors kind of expected I would go into graduate school. My older brother went on to graduate school. My older sister is there, too, so it was just a normal family process. It was no special decision that I had to be in the midst of.

DR. TOLLISON: It was the natural progression of many of you it seems

DR. TOWNES: My mother graduated from college, which was unusual in her day. She graduated from the Greenville Women's School.

DR. TOLLISON: A women's college.

DR. TOWNES: Yes, that's right, and my father graduated from Furman. They knew Furman very well. My older brother went to Furman so I appreciated Furman. It was an excellent, excellent school, and [I] had very good contact with the professors and the other students.

DR. TOLLISON: Were you involved in any extracurricular activities here? Did you go to football games?

DR. TOWNES: Oh yes, I went to football games. I didn't play football. My parents felt that I shouldn't play football because it was too dangerous. It was okay to play basketball or baseball and so on, but not football. I wasn't a great athlete. I was on the swimming team; I'm fairly athletic, but I went to football games because I played in the school band. I played the trumpet, so I played the trumpet at the football games. I marched around and played, so I went to football games regularly.

DR. TOLLISON: Tell me about your interest in languages. From what I understand, you worked in the French department when you were a student here, and later you taught yourself Japanese?

DR. TOWNES: I taught myself some Japanese, yes. Well, I like languages in general, and I like to be able to converse with other people and read other texts and so one. So I took a major in modern languages. I knew that I didn't want to be a professional in languages, but I enjoyed languages and I wanted to know as much as I could. I took a degree in modern languages, mainly French and German. I started Latin and Greek also, and I have since then, just on my own, studied some other languages: Spanish, Italian, Japanese, and so on.

DR. TOLLISON: Impressive.

DR. TOWNES: I am forgetting most of them now at my age.

DR. TOLLISON: We all forget them**.**

DR. TOWNES: I still use German and French when I'm about.

DR. TOLLISON: [Do] you travel frequently?

DR. TOWNES: I travel a great deal, yes. That's part of science. Science is international with international meetings.

DR. TOLLISON: Are you involved and have you been involved in recent decades in a great deal of international cooperation?

DR. TOWNES: Oh, yes. I just returned last week from Pakistan. They particularly wanted me to go over to help them assign some education. I felt we should make friends with the Muslims and okay, so my wife and I went over and we had a very interesting visit in Pakistan. The next week…within ten days, I'm going to Germany to advise them on some of their scientific programs in their universities…at Max Planck Institute, in particular. I am on a special committee there to advise them.

DR. TOLLISON: You'll get to speak your German.

DR. TOWNES: I'll get a little more practice with my German, yes. Of course, many of them speak English pretty well, too, but I will get some general practice. There is a lot of international cooperation in science and I've been involved in it a great deal. I'm a member of the Royal Society of England, also

DR. TOLLISON: Yes, sir. Are you concerned about the extent to which science can be used for detrimental purposes? I'm thinking about the international nature of this, and the international involvement. Does this concern you?

DR. TOWNES: I am concerned about the misuse of science. Science can be used for bad purposes and good purposes. Basically what science does, is [that] it gives humans new potentiality. It gives us more power: we can do more things. Then it is up for humans to decide whether to do good things or bad things. That's been true all along. Let's take a rock. The primitive people used rocks to crush things with them and they eat that way, or they could use that rock to hit somebody in the head and kill them. We've always been able to make good decisions and bad decisions. Science gives us even more power, and I think we need to be very careful about that and think very carefully about how we use science. Mulberry uses some of those important questions; that's why I've been glad to try to advise the Mulberry where I could and try to be helpful. I see that we can protect ourselves, but also try to prevent any danger of anybody…unnecessary endangerment.

DR. TOLLISON: Tell me about the role of faith throughout your life.

DR. TOWNES: Religious faith?

DR. TOLLISON: However you chose to define it.

DR. TOWNES: I ask that because one of my views, and I think it's a great view, is that science and religion are much more compatible than people thing. We use faith in faith in science. We call them postulates. We make postulates in science. From those postulates, we then use logic to conclude what should be the constants of these postulates. There is a famous mathematician named [Kurt] Godel whose program…yes, you use postulates, you make postulates and they prove things from

that. But see, they never prove that postulates are self-consistent. So you can never prove that you are really right. Those postulates are a lot like faith. We make postulates in our religion. We think, "Well, this is the most likely situation." And then we draw conclusions from that. We also do experiments in religion. We observe how people work, what makes a good society, [and] what makes a good life. That's life experimentation….like when an astronomer watches the stars move and he decides what's happening. So we use all of our abilities—faith, observations, logic, thoughtful, intuition…we use all of those in both science and faith. They are much more compatible than I think most people believe. I personally am very committed to spirituality. I think it's very important. Science deals with how the universe works and how it operates. Religion deals with its meaning and its significance. And the meaning the meaning and significance of the universe is really important. I think science gives us some insight on that, gives us some hints, about maybe what is the purpose of this universe. We know now from science that the universe had a beginning of all things. Most scientists didn't think the universe could have a beginning, and now we've found that it did have a beginning of all things. And also, it's very improbable that somehow…it seems very unlikely that it just happens to come out this way that we are in. It has to be almost exactly this way…all of science has to have been almost exactly the way it is for us to be here at all, and that's sheds some light on our thinking, too.

DR. TOLLISON: Do you find that your faith inspires your desire to study the workings of the universe?

DR. TOWNES: Oh yes, it does. That's part of the universe—my faith—and it's meant a lot to me in many ways.

DR. TOLLISON: I'm thinking of…I teach history of the modern world here, and we talk about the scientific revolution. We talk about all the explorers, men of faith, like Copernicus and Galileo, who were motivated so much by the faith to study God's creation of the universe.

DR. TOWNES: Sure. I have faith and, on the other hand, I'm open-minded. I'm ready to have my ideas changed. I want to think carefully about them and have my ideas changed. Well, it's silly to believe that we understand all about religion at this point. We have a lot to learn I'm sure.

DR. TOLLISON: And about science, too.

DR. TOWNES: About science, too. About science and religion and everything if we're open-minded.

DR. TOLLISON: Do you find that you have fellow scientists, fellow researchers…do they challenge your faith?

DR. TOWNES: Some do, yes, and I'm glad to talk to them. I think it's very important to discuss back and forth.

DR. TOLLISON: To engage in these discussions.

DR. TOWNES: In very careful intellectual discussions, unprejudiced discussion about such things. I think that should be encouraged.

DR. TOLLISON: Thank you so much for meeting with me today. I really appreciate it.