Nobel Voices Video History Project, 2000-2001

Interviewee: Douglas Osheroff
Interviewer: Neil Hollander
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OSHEROFF:

"What does reincarnation mean?" the cowpoke asked his friend.

His pal replied, "It happens when your life has reached its end. They comb your hair and wash your face and clean your fingernails, and place you in a padded box away from life's travails. The box and you goes in a hole that's dug into the ground. Reincarnation starts when you're planted 'neath the mound. Them clods melt down, as does your box and you who is inside, and then you're just beginning on your transformation ride.

"In a while the grass will grow upon your rendered mound till one day a lonely flower is found upon your moldered mound. And say a hoss should wander by and graze upon that flower that once was you but now has become your vegetative bower. Supposedly that the hoss that ate up with its other feed makes bone and fat and muscle essential to the steed. But some is left that he can't use and so it passes through, and finally lays upon the ground this thing that once was you.

"And say that I should wander by and spies this on the ground. And I ponders and I wonders at this object that I found. I think that reincarnation of life and death and such me becomes away concluding, 'Slim, you ain't changed all that much.'" [Laughs]

That won a Cowboy Poetry National Contest a few years ago.

HOLLANDER:

It sounds like Robert [inaudible].

OSHEROFF:

No, no, no. I know the *Cremation of Sam McGee*, of course, too, but there's another one that you wouldn't identify with him.

HOLLANDER:

[inaudible]

OSHEROFF:

Yes, yes, but, yes, I know the whole thing. I also think I might know the entire *Raven*.
HOLLANDER:

[inaudible]

OSHEROFF:

No, no, just one. But there's this other one. "If ever you've heard of the land beyond that gleens the gates—." You know that one, too?

HOLLANDER:

[inaudible]

OSHEROFF:

Well, I don't know the third stanza. "Alluring it lies at the skirts of the skies and ever so far away. Alluring it calls and [unclear] calls and [unclear] the trail over fawn. The saddle and pack by paddle and track would go to the land of beyond. If ever you stood where the silence is brewed, the vast horizon begins, at the dawn of the day to behold far away the gold you will strive for and win. Yet on the night as you rise to the height to the vast pool of heaven stars spawned." I can't remember the last few words. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:
"Arctic trails of the [inaudible], it would make your blood run cold. [inaudible] Is that night on the margin of Lake LaBarge [phonetic] when I cremated Sam McGee."

Yes, poetry's fun.

HOLLANDER:

[inaudible]

OSHEROFF:

Okay. [Laughs]

HOLLANDER:

I think we'd better have you introduce yourself and saw what it is you do.

OSHEROFF:

My name is Douglas Osheroff. I'm a professor of physics at Stanford University. I do research in the properties of materials close to absolute zero temperature.

HOLLANDER:

And you won the Nobel Prize for?

OSHEROFF:

I won the Nobel Prize for work which I'd done as a graduate student in 1971-'72, which resulted in the discovery of three super fluid phases of helium-3, temperatures within 2.5 thousandths of a degree of absolute zero.

HOLLANDER:

[inaudible]

OSHEROFF:

Why do you want to know that? I have no idea why you want to know that. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

Okay, what is the value in this? Okay. Well, anything that happens that close to absolute zero has no technological or economic value. But these are remarkably complex ordered states which arise from one of the simplest fluids known to man. They're extremely well understood, and they have been a classroom for the physics community to understand the nature of a particular kind of order, which is actually very similar to superconductivity. So these are, in a sense, neutral analogs to superconductors, and in particular they're rather close to the high-temperature superconductors, but there's no lattice in the way.

The things that form Cooper pairs that result in the super fluid or superconducting weigh function, in this case are atoms and not electrons, and there's nothing there. So it's a really remarkable system, and it has unique properties which make it, in addition, a testing ground for our models of a broad diversity of things, such as the nature of what happened in the early universe, whether there was a condensation that resulted in the formation of cosmic strings. It appears that super fluid helium-3 is the best system to test

that hypothesis.

HOLLANDER:

[inaudible]

OSHEROFF:

What do you mean by "metaphysics"? [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

Do I have a deep abiding faith in something? No, I'm not a religious person. Ironically, my father was an atheistic Jew, and my mother was the daughter of a Lutheran minister. I grew up in the Lutheran church, and while I would like to think there is a god, I have trouble believing in church dogma, the sorts of things that one has to repeat every Sunday, and eventually I stopped going to church. But I think that I have no trouble with religion, and I daresay that I see no conflict between religious beliefs and love for physics.

HOLLANDER:

[inaudible]

OSHEROFF:

It was very interesting. When I was in high school, I was really deeply philosophical. I did not assume that the Bible provided the moral compass, and I kept asking myself, "What is man's destiny? What should be his guiding principle?" I daresay I never really found answers to those questions and, ultimately, I decided I would simply accept the ethical values of my parents. They were very ethical people. I think that I've done very well by those values.

HOLLANDER:

How did you become interested in science? [inaudible]

OSHEROFF:

Well, I would say that it was probably the influence of my father more than anything else. When I was, I think, six years old, I started tearing apart my toys to get the electric

motors out, because I just wanted to play with them and understand how they worked. But my parents, rather than chastising me and sending me to bed without my dinner or something, encouraged this behavior. My father became a provider of all sorts of things for me to tear apart. I daresay that when I was eight, he gave me the camera, or mistakenly gave me the camera, that he'd used as a child. He would come home—he was a physician, would come home for lunch, and then take an hour's nap before going back to the office. By the time he got up, that camera was in little tiny pieces all over the living room carpet, never, ever to go back together again. But not even at that moment did he raise his voice.

As time went on, I just got intrigued by all manner of things. He actually, at that point, brought home a used watch and some of these little tiny screwdrivers and suggested I learn how to take it apart and put it back together again. And I did. In fact, I got rather good. It's interesting, there were always parts left over. The watch would run—or watches. I did several of them. I never understood why they put those extra parts in watches.

Anyway, so I was interested in everything, particularly electricity and magnetism. I just found that so fascinating. I got into high-voltage electricity in a big way. I started with capacitors and discharging them across spark coils and getting sparks that long. Then eventually I got a neon sign transformer, 15,000 volts, and made a Jacob's ladder, went on to 100,000-volt x-ray machine my senior year in high school.

So I was, you know—it would be amazing if I'd gone into anything else. However, when I was a senior in high school, I was also editor or co-editor of my high school newspaper. I almost went into journalism. I was infatuated with the sort of powered responsibility of the press to mold public opinion, and I had a great time working in the high school newspaper. I would have been a miserable journalist, someone that reads slowly and can't spell at all. It would have been a real mistake.

But I always tell my freshmen advisees at Stanford this story, and the moral is, in fact, when you think about what you'd like to do for your life's work, don't be attracted because of some very high ideal. You need to do something where you enjoy the day-to-day activities of whatever that process is. In my case, physics is it. I just truly enjoy every aspect of it.

HOLLANDER:

[inaudible]

OSHEROFF:

Oh, physics is fun. There's no question about that. I daresay I doubt there's anyone here that you could ask that question of who would say anything other than, "I got in it because of the fun." It's really a game that you play with nature. You try to learn what

you can about nature, and nature, of course, being a devious woman, tries to keep you from learning anything. So it's devising experiments which probe the behavior of nature in a realm and a scale in which man cannot possibly see and understand in detail what's going on there. It's a fun game, building the apparatus, designing it, doing experiments, and trying to understand what it is you're seeing. I love to work with theorists. I'm an experimentalist, but certainly my best experiences have been doing experiment alongside theorists, who then we work together very well in deciding what to do next.

HOLLANDER:

[inaudible]

OSHEROFF:

Well, I daresay when—I was attracted as—I think my generation of physicists are noted for having fingers missing. Most of us got involved in explosions at one time or another. I think the closest thing that I ever really came to getting in real trouble was when my muzzle-loading rifle went off in the house and put a hole through two walls. Luckily, no one was watching television at the time, or I may be in Leavenworth Prison or something like that now.

Everything. My youngest brother and I, every New Year's Eve, would blow off some explosion exactly at midnight. One year he got hold of some electronic blasting caps, and we decided that would allow us to do this exactly at midnight. No fuses involved. Well, this mixture of black powder and nitro-cellulose-based gunpowder that we had, smokeless powder, when the blasting cap went off, this stuff didn't just start burning; it detonated. I must have come very close to breaking every window in the house. We dug a crater three feet wide, two feet deep, and threw 200-pound rocks around. My father, he complained for years that the rock garden was never the same after that. [Laughs]

Well, whenever I did things that were really crazy and dumb, that would be it. No more of that. And we didn't ever have any arguments about these things. My parents just never realized that everything else I did was equally dangerous.

There was one time—this is a great story—I was using calcium carbide to generate acetylene like used in a miner's lamp, and normally you put a little grain of calcium carbide in a Coke bottle largely filled with water, and you put a stopper with a glass tube on the end. Well, I decided to do it the other way around. I had a large beaker, and I had a burette which would drip water into this thing, which was largely filled with calcium carbide. Then there was a delivery tube.

I didn't wait long enough for the air to get out of the system. I lit the delivery tube, and rather than getting this intense white flame, I got a putrid blue one. I instinctively turned my head to the side, and this thing blew up. The largest piece of glass was about half the size of my little fingernail, and it was sticking in the side of my face. So my mother had

been up fixing dinner, and she came to the top of the stairs, and by that time I was coming up the stairs, but I was cupping my head like this [demonstrates] to keep the blood from dripping on the carpet.

Well, she knew that I was big on practical jokes, but she was just mortified by what she'd heard, and seeing me come up like that, she said, "If you're kidding, I'll kill you." So I drove myself down to my father's office, and he sewed me up. That was very standard back in those days.

HOLLANDER:

Do you have children?

OSHEROFF:

No, unfortunately, I don't. It was interesting, I always thought that I would marry someone like my mother, who would be a good homemaker and that was it. After a while, I began to realize how really, I don't know, *obsessed* is not the right word, but how dedicated I was to doing physics, and I felt it wouldn't be fair for me to marry someone that didn't understand that commitment.

Just as I was kind of thinking about this, I re-met someone that I'd met when I first came to Cornell University, Phyllis Liu, who is now Phyllis Liu Osheroff. Anyway, we've been married for thirty years. She's a protein biochemist, and we've had really fascinating times together. We both enjoy our careers, but no children. But I always tell the students at Stanford that I think of them as my children, particularly the freshmen advisees, and that in my old age will come and visit them, and that really makes them choose a major really fast. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

Well, as soon as they get a major, then they don't have a freshman advisor anymore. I enjoy young adults, had a great time over the years talking with my students and my advisees at Stanford.

HOLLANDER:

[inaudible]

OSHEROFF:

Oh, lord, I don't know that—I mean, I can only think of one right now, and that's just—but everyone's heard this. There are two atoms walking down the street, and one says, "Oh, my god, I just lost an electron."

The other one says, "Are you sure?"

The first one says, "Yes, I'm positive."

Well, you must have heard that one before. [Laughs] I'm not big on science jokes.

HOLLANDER:

[inaudible]

OSHEROFF:

Oh, well, yes, I don't know. Everyone's had. Yes, I've certainly had embarrassing moments. I don't know what's the most embarrassing. Of course, when you're teaching students, I daresay, particularly in entry-level physics, it's actually good to have an embarrassing moment now and then. The students somehow feel you're more human, and so I will always shock myself. It hurts a little bit, but it's always worthwhile.

You know, I don't remember too many accidental embarrassing moments. I suppose the worst thing is, I'm terrible with names, and I run into people that I know very well and can't muster their name. But I suppose that happens to everyone. It just happens to me all the time.

HOLLANDER:

What kind of student were you [inaudible]?

OSHEROFF:

Oh, you know, in high school I was valedictorian in my high school class. I should say that in grade school I actually didn't care very much about my grades. As I said, I've always been a bad speller, so I always got at least one really bad grade. I was good at math and particularly good at science. Those were the things I enjoyed the most.

I told you about the experimentation. Well, one time my father brought home a bunch of parts from the telephone company, and I was connecting a solenoid-actuated relay to a 22-volt battery. When I removed the leads, I got a shock. It's just Faraday's effect, which I didn't understand, but I understood the market potential this thing had. So I packaged this in a duffel bag with just a lamp cord sticking out so that the students squeezed the two prongs together. When they released them, they got a shock. There were kids twenty deep lined up—I was ten years old—-to get shocked by Osheroff's

machine.

After that, people started calling me "the brain." I can tell you that the social enigma or stigma associated with being called "the brain" is pretty severe. [Laughs] But, you know, then I went to Caltech, and that was a real eye-opener for me, because I had always been pretty much the top in my class, and suddenly I found myself struggling to be above average. I hadn't had any calculus when I got down there. Most of my classmates have had at least a semester, and a lot of them had had a full year. We'd have weekly tests in calculus, and I failed the first one. I got a C-plus for calculus the first term. It was a real eye-opener.

I basically had to reinvent my personality. I had to be able to start laughing at myself. That's been a very valuable thing to do over the years. Anyone that can't laugh at themselves, they've got a weakness.

HOLLANDER:

[inaudible]

OSHEROFF:

[Laughs] Well, it's interesting. I'm a slow reader, as I said, but, you know, I like adventure books, but not novels. For instance, I suppose the last book I read was this book on the [Ernest] Shackleton expedition, called *The Endurance*. Of course, it has these spectacular reproductions of these photographs taken by the photographer on board that expedition. Well, my consuming passion is actually photography. In fact, I took 10 percent of what was left of the Nobel Prize, after I paid Uncle Sam and Pete Wilson, governor of California at the time, and bought myself a Hassleblad, the camera of my dreams, I suppose. You know, I take it with me. That one's expensive, so I don't take that one with me all the time, but I always take a medium-format camera with me wherever I go, and, you know, I've been traveling 100,000 miles a year, so I've been to some pretty exotic places. The end of this week, my wife and I will be driving to Chamonix in France, and we just are looking forward to shooting the area around Mont Blanc.

HOLLANDER:

[inaudible]

OSHEROFF:

Well, it's interesting. I spent fifteen years at AT&T Bell Laboratories in Murray Hill, New Jersey, and I had no responsibilities back then except doing the best science I could, and I had lots of great people to collaborate with. Those were fifteen really remarkable

years. But I knew that eventually I had to start paying the price. That is to say that everyone that has the ability, I think, has to be a good citizen, and so particularly, of course, once you get to universities, committees are the bywords. I became members of committees at the department level, at the school level, at the university level, at the national level, at the international level.

So, you know, I wouldn't say that I've been a very good citizen, but I've certainly been involved in lots of these things. I mean, I guess the year after I got the Nobel Prize, the American Physical Society called me up and asked me if I would agree to run for vice president. Well, that's really another way of saying, "Will you agree to be president?" I had to tell them that they should call me back in five more years. I was just too busy at that point to take on something like that. It's a big responsibility. The American Physical Society is a large organization, and the person that's president really sets the agenda. I just don't think I have the time to do that right now.

HOLLANDER:

[inaudible]

OSHEROFF:

Outside? Well, I mean, there's not much time left if you're at a university, especially a place like Stanford that really pushes faculty to, you know, contribute more than just teaching to their undergraduate students. So, you know, I spend a lot of time teaching. Actually, this past term I taught a course for freshmen, to freshmen, on technical photography. We went out and went up to the Golden Gate Bridge and took pictures. I managed to get a key to the Stanford Memorial Church, which is really quite beautiful inside, so students could go in and do architectural photography.

But, you know, it, those things take time to develop and time to do. I do freshmen advising, sophomore advising, usually have about a dozen physics major advisees. I think on a given year, I'm probably giving thirty to forty different lectures nationally, internationally. I'm on a lot of committees. There isn't much time left over. I have piles of photographs that I've taken years ago, that are sitting, waiting to be sorted and stored away somewhere, and they don't get done.

HOLLANDER:

[inaudible]

OSHEROFF:

Yes, fair enough. Why don't you ask me some questions about what it's like being a physicist or doing physics or anything like that?

HOLLANDER:

[inaudible]

OSHEROFF:

I daresay that there was a young woman who will be coming to Stanford next fall that I met at a talk that I gave at Old Dominion University in Virginia, probably, well, two and a half years ago now. I ended up sitting next to her before I gave my lecture, and she asked if she could have my e-mail address. Well, she's kind of an interesting person. She sent me e-mail and proposed that we do an experiment. She said that she would collect questions from her class, from her physics class, and that she would screen them and send me one per week, which I would then answer, and she would post the answers up on the bulletin board.

Now, at first I was very disappointed because few of the questions actually had anything to do with physics. They had a lot to do with what it's like being a physicist and what it's like being a Nobel laureate, too, of course. But some of them were quite interesting questions, and in the end, I decided it was quite a successful venture. Anyway, it was fun, and what I realized at that point was that people can learn physics by reading books. But learning what it's like being a physicist and what your attitudes are and all that stuff, that you have to talk to physicists to get, I think.

HOLLANDER:

What were some of the questions [inaudible]?

OSHEROFF:

Well, questions about, you know, working late at night and things like that. You know, how do you accommodate that in your family and stuff? You know, when do you find you get your best results? You know, what was the most exciting moment of your career?

I remember that very well. That was when I was involved in these discoveries that netted us the Nobel Prize, but, of course, back then no one was thinking Nobel Prize. But it was November, I think it was the twenty-fourth, which is the day before Thanksgiving, 1971, when we first had an indication that there were phase transitions in this cell that was at very low temperatures that weren't expected. We spent the next seven months understanding what those phase transitions were. But the first real breakthrough where we really understood correctly what the nature of at least one of these three transitions was, was attained, I think it was April 20th, and I had taken care of the cryostat, putting the cryostat to bed, so to speak, transferred the liquid cryogens in and everything like that, and it was, I guess, about one-thirty in the morning.

I started looking over this old data I'd been taking for the last few days. It was nuclear magnetic resonance data, and there was clearly a liquid signal there and a solid signal. We thought these transitions were in the solids. That evening, I looked at this little liquid signal and noticed, in fact, that at this particular transition, which is called the B transition, the NMR signal in the liquid changed by about a factor of three. It decreased by a factor of three. One understood that if one formed Cooper pairs, that they would form with one spin up and one spin down. This, in fact, would not contribute to the NMR signal.

So I knew right away, and I wrote in the lab book, "Have discovered the BSC transition in liquid helium-3 tonight." That was at 2:40 in the morning. Now, ironically, the call I got from Stockholm was at 2:30 in the morning, very close time. But I would say that the most exciting time was that moment. It turns out I was the only person in the entire physics building that night, so I ran around to find every—I wanted to tell everyone this, of course, and not a soul was there. Eventually, at four in the morning, I called up my thesis advisor. I always tell my graduate students that they should feel free to do that as well, but it better be good. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

Yes. He called me back at six a.m. for more details. So I didn't get any sleep that night at all. The night I got the call from the Nobel Foundation, it was from the, I guess, the Royal Swedish Academy of Sciences, I got two and a half hours of sleep.

HOLLANDER:

[inaudible]

OSHEROFF:

Well, ironically, you know, we thought that if—there was a guy named John Wheatley, who passed away several years ago, had a bad heart. He'd done a lot of work in our understanding of the normal phases of liquid helium-3. Our feeling was that if he'd made this discovery, he might be in line to get a Nobel Prize sometime, but we were just spoilers. That was my attitude. And I suppose it was about six years later that people started coming up to me and telling me that they'd nominated me for the Nobel Prize, which you're not supposed to do. They specifically tell you that you're not to do that.

So first, I didn't think much of it, but then after a while, you know, you start thinking that maybe, you know, is this going to be the year, and you get very nervous. My attitude usually was, jeez, I was so busy, I couldn't imagine, you know, getting a Nobel Prize.

How would I possibly accommodate the additional workload? I daresay that there has been a lot added to what I normally do. I think the best time to get a Nobel Prize is just as you're retiring. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

Now I can, and, in fact, I won't say who it was, but, in fact, I started nominating, I think two years before I got the Nobel Prize. The Royal Academy of Sciences, Swedish Academy of Sciences, will tend to ask all of the senior faculty at a particular institution, invite them to nominate, and then they look to see if they actually make serious nominations. If they do, then, in fact, they will continue to be invited. So I made a serious nomination the first year, and I actually, I think, I resubmitted that three times. Eventually, I won. We won. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

Yes, or that it was a group of three. Usually, in physics, it's three people that get the Prize.

HOLLANDER:

[inaudible]

OSHEROFF:

I don't know. I mean, I think part of it is that usually groups of people are involved in major advances. I guess sometimes a single theorist will get the prize, but usually if it's experimentalist, it's more than one.

HOLLANDER:

One last question. Where are we going from here [inaudible]?

OSHEROFF:

Oh, well, I mean, it depends on whose calendar you look, I suppose, right? It's like when you turn a year older, you're really only a day older. So I don't take very much of that.

Personally, I think that physics is alive and well, and I daresay I think that the most exciting of the sciences right now is biology. There's no question about that.

I also think that it would have been a disaster for me personally to go into biology. It's not the sort of thing that I enjoy, and it requires a lot of talents that I'm kind of weak at. Biology requires you to really know a lot of stuff. Physicists, they just have to know how to derive it. It's a completely different sort of environment. My wife's a biologist, as I said. So I know the sort of life that she has and what that's like.

HOLLANDER:

What are some of the things you dislike?

OSHEROFF:

Oh, I don't know. I mean, I guess the worse thing, in terms of doing research, when it comes time to wire you up a cryostat, it's the worst thing. That's the slowest part of it. I always say you should do the worst part the fastest and get it over with, but it never happens. It always draws out. You know, in terms of science, the process, I enjoy everything.

I guess negotiating with graduate students now to get the paper out, that's tough. These guys, of course, use these fancy programs that I don't know anything about, like Latech and stuff like that. I always use Word, even though I don't particularly like Word. So, you know, there are frustrations, of course, associated with dealing with students in any event, but, boy, when a student suddenly becomes a real scientist, it's pretty exciting. When they start teaching you things rather than the other way around, you've got a winner there.

HOLLANDER:

[inaudible]

OSHEROFF:

Oh, that's one. Avocados. I don't like avocados. I hate raw onions.

HOLLANDER:

[inaudible]

OSHEROFF:

I may be the only one from California. They may kick me out of the state now, I don't know.

HOLLANDER:

[inaudible]

OSHEROFF:

Well, no, I like broccoli, actually, as long as it's not over steamed. No, I'm pretty—I daresay when I was young before I went off to Caltech, I was a very picky eater, didn't like vegetables at all. I think now, I don't think there's anything I really dislike, except a few things which are—I don't like internal organs, I daresay, but I think there are a lot of people that agree with me on that one.

HOLLANDER:

What's your favorite movie?

OSHEROFF:

Favorite movie. I don't know. Well, I tell you that one of the—I like a lot of movies. We don't go see movies. We like to watch them on television, that way I don't have to watch the whole thing, and I can be doing something else like paying the bills. But the movie *Men In Black*, I just thought that was great fun.

But getting back to something you asked me about, you almost asked me, was did I have a role model or did I have a hero. No, I actually didn't. I mean, I thought of, you know—I knew, of course, of Einstein and people like that. I didn't even think of myself of as, you know, I can't approach someone like that. I thought that this was not someone that I could possibly approach in terms of what he had done. So he was not a hero; he was a legend to me. And I don't think I actually had any role models. I mean, I grew up in a logging town in Washington State. My mother's attitude, we were five kids, and she said she doesn't care, you know, how well or how badly we all do, just as long as we do the best we can. I guess I've always pushed to try to do the best I can at whatever I do.

HOLLANDER:

[inaudible]

OSHEROFF:

Oh, you know I don't read very many books. [Laughs]

HOLLANDER:

[inaudible]

OSHEROFF:

I don't know. Most of the ones I thought were sexy are getting old now. [Laughs] Okay. I hope you have—

[End of interview]