CHEMICAL HERITAGE FOUNDATION

PRADIP RAYCHAUDHURI

The Pew Scholars Program in the Biomedical Sciences

Transcript of an Interview
Conducted by

Andrea R. Maestrejuan

at

University of Illinois at Chicago School of Medicine
Chicago, Illinois

on

1 and 2 November 1997

From the Original Collection of the University of California, Los Angeles

Pradip Raychaudhuri

ACKNOWLEDGEMENT

This oral history is part of a series supported by a grant from the Pew Charitable Trusts based on the Pew Scholars Program in the Biomedical Sciences. This collection is an important resource for the history of biomedicine, recording the life and careers of young, distinguished biomedical scientists and of Pew Biomedical Scholar Advisory Committee members.

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Interviewee agrees to participate in a series of University conducted tape-recorded interviews, commencing on or about November 1, 1997, and tentatively entitled "Interview with Pradip Raychaudhuri" This Agreement relates to any and all materials originating from the interviews, namely the tape recordings of the interviews and a written manuscript prepared from the tapes, hereinafter collectively called "the Work."

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INTERVIEWEE

Signed release form is on file at the Science History Institute
(Signature)

Pradip Raychaudhuri
(Typed Name)

Department of Biochemistry

University of Illinois, Chicago
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Date 11/02/97

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REFORMATTING:

David J. Caruso, Program Manager, Oral History, Chemical Heritage Foundation. B.A., History of Science, Medicine, and Technology, Johns Hopkins University; PhD., Science and Technology Studies, Cornell University.

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PRADIP RAYCHAUDHURI

1958 Born in Calcutta, India, on 4 January

Education

1980 B.S., Chemistry, Calcutta University, Calcutta, India
1983 M.S., Molecular Biology, Albert Einstein College of Medicine of Yeshiva University
1986 Ph.D., Molecular Biology, Albert Einstein College of Medicine of Yeshiva University

Professional Experience

Rockefeller University, New York City, New York
1986-1987 Postdoctoral Fellow

Duke University, Durham, North Carolina
1987-1990 Postdoctoral Fellow,

University of Illinois at Chicago
1990-1996 Assistant Professor, Department of Biochemistry
1996-present Associate Professor, Department of Biochemistry

Honors

1986-1989 Damon Runyon-Walter Winchell Cancer Research Fellow
1992-1996 Pew Scholar in the Biomedical Sciences

Selected Publications

Raychaudhuri, P. et al., 1985. Eukaryotic initiation factor 5 from calf liver is a single polypeptide chain protein of Mr.=62,000. Journal of Biological Chemistry 260:2132-39.

Raychaudhuri, P. et al., 1985. Formation and release of eukaryotic initiation factor-2.GDP complex during eukaryotic ribosomal polypeptide chain initiation complex formation. Journal of Biological Chemistry 260:2140-45.

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specific DNA binding. Molecular and Cellular Biology 9:578-85.
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Raychaudhuri, P. et al., 1991. Domains of the adenovirus E1A protein that are required for oncogenic activity are also required for dissociation of cellular transcription factor complexes. Genes and Development 5:1200-211.
Shiyanov, P. et al., 1996. P21 disrupts the interaction between cdk2 and the E2F/p130 complex. Molecular and Cellular Biology 16:737-44.
Morozov, A. et al., 1997. Accumulation of the HPV16 E7 protein bypasses G1 arrest induced by serum-starvation and by the cell cycle inhibitor p21. Journal of Virology 71:3451-57.
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ABSTRACT

Pradip Raychaudhuri grew up in Calcutta (Kolkata), India, the oldest of seven children. His father was a pharmacist, his mother a housewife. As a youngster he played cricket and soccer and followed the professional teams. His father wanted him to be a surgeon, but he was more interested in mathematics and the physical sciences. Raychaudhuri's maternal grandfather influenced him greatly in mathematics, working problems with him from an early age. His father inspired his interest in the Hindu religion and in philosophy, believing that Hinduism and science are compatible. Reading about scientists engaged his interest in being a scientist, and he performed well at school in the subjects he liked. Because he felt that the Indian system of graduate education was not as good as in the United States, he decided to study here.

Raychaudhuri applied to several universities in the United States; he chose Albert Einstein College of Medicine of Yeshiva University in part because he had heard talks from an Indian and an American who were at Einstein. He began studying protein synthesis in Umadas Maitra's lab, working in the lab around the clock. As an undergraduate he had been interested in cancer research, and he shifted back to it from enzymology. Homesick at first, he struggled with American culture in addition to finding the program at Einstein rigorous. He met his wife, Srilata Bagchi, a postdoc at Einstein, and they married after he completed his thesis defense.

Raychaudhuri accepted a postdoc in the Joseph R. Nevins lab at Rockefeller University. There he showed that E1A activates transcription factors by removing tumor suppressors. Working in a competitive field, Raychaudhuri had to devise research projects that would enable him to compete against larger labs. He began studying the E2F-Rb complex's relationship to tumor suppressors and investigating whether replication gene expression is regulated through damaged DNA binding. Drug resistance in cancer patients was an important stimulus to Raychaudhuri's desire to find clinical applications for his research. Explaining his failure to obtain funding to determine an RNA-binding protein's relationship to Rb led to a discussion of grant writing, of the balance between clinical and basic science, and of his recent funding history and future funding prospects.

After three years as a postdoctoral fellow at Duke University Raychaudhuri accepted an assistant professorship at the University of Illinois College of Medicine; he has since received tenure. He concluded the interview talking about taking his daughter to the lab; his reasons for remaining in the United States; the need to publicize one's science; the quality of graduate students and postdocs at Illinois; the need for the university to improve the quality of its scientists and research; and his definition of good science. The interview ended with an explanation of the impact of the Pew Scholars Program in the Biomedical Sciences funding and annual meeting on his career.

UCLA INTERVIEW HISTORY

INTERVIEWER:

Andrea R. Maestrejuan, Interviewer, UCLA Oral History Program, B.S., Biological Sciences, University of California, Irvine, 1986; M.A., History, University of California, Riverside, 1991; C.Phil., History, University of California, Riverside.

TIME AND SETTING OF INTERVIEW:

Place: Raychaudhuri's office, University of Illinois at Chicago College of Medicine

Dates, length of sessions: November 1, 1997 (112 minutes); November 2, 1997 (129).

Total number of recorded hours: 4.70

Persons present during interview: Raychaudhuri and Maestrej uan.

CONDUCT OF INTERVIEW:

This interview is one in a series with Pew Scholars in the Biomedical Sciences conducted by the UCLA Oral History Program in conjunction with the Pew Charitable Trusts's Pew Scholars in the Biomedical Sciences Oral History and Archives Project. The project has been designed to document the backgrounds, education, and research of biomedical scientists awarded four-year Pew scholarships since 1988.

To provide an overall framework for project interviews, the director of the UCLA Oral History Program and three UCLA faculty project consultants developed a topic outline. In preparing for this interview, Maestrejuan held a telephone preinterview conversation with Raychaudhuri to obtain written background information (curriculum vitae, copies of published articles, etc.) and agree on an interviewing schedule. She also reviewed prior Pew scholars' interviews and the documentation in Raychaudhuri's file at the Pew Scholars Program office in San Francisco, including his proposal application, letters of recommendation, and reviews by Pew Scholars Program national advisory committee members. For technical background, Maestrejuan consulted J.D. Watson et al., Molecular Biology of the Gene. 4th ed. Menlo Park, CA: Benjamin/Cummings, 1987; Bruce Alberts et al., Molecular Biology of the Cell. 3d ed. New York: Garland, 1994; and Horace F. Judson, The Eighth Day of Creation. New York: Simon and Schuster, 1979.

The interview is organized chronologically, beginning with Raychaudhuri's childhood in Calcutta, India, and continuing through his graduate work at Albert Einstein College of Medicine of Yeshiva University, his postdoc in the Joseph R. Nevins lab, and the establishment of his own lab at the University of Illinois at Chicago. Major topics discussed include his work on viral oncogenes, scientific funding, and the relationship of clinical and basic science.

ORIGINAL EDITING:

Gregory M.D. Beyrer, editorial assistant, edited the interview. He checked the verbatim transcript of the interview against the original tape recordings, edited for punctuation, paragraphing, and spelling, and verified proper names. Words and phrases inserted by the editor have been bracketed.

Raychaudhuri reviewed the transcript. He verified proper names and made minor corrections and additions.

William Van Benschoten, editor, prepared the table of contents, biographical summary, and interview history.

Ödül Bozkurt, editorial assistant, compiled the index.

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INTERVIEWEE: **Pradip Raychaudhuri**

INTERVIEWER: **Andrea R. Maestrejuan**

LOCATION: **University of Illinois at Chicago School of Medicine Chicago, Illinois**

DATE: **1 November 1997**

MAESTREJUAN: I'll go ahead and just start at the beginning and ask you when and where you were born.

RAYCHAUDHURI: I was born in Calcutta, India, and it was January 4, 1958.

MAESTREJUAN: Can you tell me a little bit about your family background? Do you have any brothers and sisters?

RAYCHAUDHURI: Oh, yes. My father [Phani Bhusan Raychaudhuri] used to be a pharmacist in Calcutta. I have five sisters and one brother. Three of the sisters are older than me.

MAESTREJUAN: Your father being a pharmacist, he must also have received a university education, or how did that work?

RAYCHAUDHURI: I think he finished college. Back then--it's a long time ago--I think after finishing school there is a pharmacist's school that you go to, and that's where he went. He was probably trained for three years or so in pharmacist school.

MAESTREJUAN: And your mother? Did she work outside the home?

RAYCHAUDHURI: No.

MAESTREJUAN: It sounds like she had plenty of work to do inside the home.

RAYCHAUDHURI: Right, right.

MAESTREJUAN: Particularly at this time, I think most of our images of Calcutta come from the scenes surrounding Mother Teresa, just because of her recent death. Perhaps you could talk a little bit about growing up in Calcutta and your own experiences.

RAYCHAUDHURI: You know, I came to New York, and from Calcutta to New York was such an easy transition. So that tells you how Calcutta is. It's diverse, it's a cosmopolitan city--easy to see everything, easy to do everything if you want to. But it is a very old city, and right now it has gotten dirtier. Dirtier meaning it's not maintained very well compared to the other cities in India. The Mother Teresa thing that you saw, if you saw the Peter Jennings program, they were focusing on the nicer part of Calcutta. They're not really-- [laughs] But growing up in Calcutta was actually a lot of fun because of the culture. It's a very rich culture. You know, friends and-- It's nice in many ways. You do not know how life could be when you come to a different country and see different things, but as someone growing up in Calcutta who doesn't know the outside world, it's actually fun.

MAESTREJUAN: What kind of neighborhood did you grow up in?

RAYCHAUDHURI: I was actually in a good part. It ' s in the real center of Calcutta--the city was built by the British, and it's where many of these big British people used to live--in that kind of neighborhood. So it was very well built, big streets. It's not the-- When you hear about Calcutta, you hear about slums in Calcutta. I was nowhere near those things, fortunately. They're actually a little outside Calcutta, those slums, and I rarely got to see them. Only when I was going outside Calcutta, it is only then you get to see those things.

MAESTREJUAN: What did you do for fun in your neighborhood? I mean, if you grew up in New York or Chicago, you would go out and play stickball.

RAYCHAUDHURI: Well, we played stickball. We did not play baseball, but we used to play cricket.

MAESTREJUAN: Oh, that's right.

RAYCHAUDHURI: We used to play cricket, which is--

MAESTREJUAN: Kind of the original stickball.

RAYCHAUDHURI: That's right. This game is played I think all over India. They also have a good international team. And I used to play soccer a lot. Back then when I was growing up, soccer in Calcutta was pretty exciting. There were good teams, there was the league. Within Calcutta there were like twelve or fifteen teams, different clubs. They played a league and basically we used to go there and watch the games. So those are the fun parts.

MAESTREJUAN: Well, to get back a little bit to your parents, what expectations did they have in regards to what they wanted their kids to become or do with their lives?

RAYCHAUDHURI: When I came to [Albert] Einstein [College of Medicine of Yeshiva University], I saw this Jewish medical student or graduate student. They kind of reminded me, my parents, that I have got to study. That is the only thing you do. [laughs] So that was not fun in that way. What was the other thing you asked?

MAESTREJUAN: I guess they expected you to go to the university?

RAYCHAUDHURI: Oh, yes. My father was very strong that I do well in school so that I can get into a medical school. He was very adamant that I go to medical school because he was a pharmacist and he had a lot of friends who were basically health professionals. So he wanted me to become a doctor or a physician.

MAESTREJUAN: What kind of physician? Clinician versus perhaps more of a--

RAYCHAUDHURI: You know, those were his dreams. When it came to making a decision, we didn't get along at all. [laughs] So that was kind of a first conflict that I had with my father. I did not want to go to medical school. He wanted me to go to medical school. He had this ambition that I would become a surgeon.

MAESTREJUAN: At what age in India does a student have to think about decisions of going to medical school?

RAYCHAUDHURI: The system has changed a little bit now, but back then we finished schooling after twelve years. So finish eleventh grade and at that point you can choose to go to medical school, engineering school, or just general education--like what I did--go for bachelor's degrees in science or humanities.

MAESTREJUAN: So immediately from, say, your primary education and early secondary education you would apply directly to medical school, as opposed to an American system where you have the distinct undergraduate and then medical education.

RAYCHAUDHURI: Right, right. So the degree they give out is actually a bachelor's degree. In this country they give out an M.D., but they give out M.B., B.S. So that's a bachelor's degree. But they have the same type of entrance exam that you have to take in this country, and apparently the top students, just like this country, get to go to the medical school. The engineering school is also very attractive, unlike this country, because finding a job is much easier.

MAESTREJUAN: Were these same expectations shared by your siblings? Did your parents expect your siblings to go to the university in some kind of health-related field?

RAYCHAUDHURI: Well, you know, I was the first son, and the expectations-- Too much expectation on me to do certain things. My brother had a lot easier life in that regard. My sisters, they all studied humanities. Even at an early age, they were not good in math. They never showed interest in science. They were more interested in subjects like history, language. As a result, my father knew that they were not going to go to medical school. [laughs]

MAESTREJUAN: But he expected them to go to get an education.

RAYCHAUDHURI: Yeah, right. They all obtained master's degrees.

MAESTREJUAN: What do they do? You can just start at the top and go down.

RAYCHAUDHURI: My eldest sister [Anjali Mukhopadhyay], she used to teach in a school. She had a master's in a language which-- Sanskrit. I do not know if you have ever heard--

MAESTREJUAN: Oh, my goodness, yeah.

RAYCHAUDHURI: That language I don't think exists anymore, maybe in some parts of India. So she used to teach in a school. Right now I don't think she does any school teaching. I think she is basically at home. The next one [Aradhana Mukhopadhyay], she has taken jobs on and

off, again in schools, but never held a permanent job. The next sister [Sadhana Acharya] , she's a housewife. She loves children, and that's what she is doing. These sisters, they don't work. They basically stay home.

MAESTREJUAN: And what does your brother do?

RAYCHAUDHURI: He [Pranab Raychaudhuri] works for a company in sales. He's basically a sales manager kind of person.

MAESTREJUAN: And are your parents and your siblings all still in India, in Calcutta?

RAYCHAUDHURI: Not in Calcutta, but they are in India. They are in different parts of India.

MAESTREJUAN: Given that he wanted his eldest son to go to medical school, how did your father encourage you? Did he stick a microscope in your hand when you were five years old? How did he encourage you, with this interest that you needed to go to medical school?

RAYCHAUDHURI: It was kind of a long fight between me and him. See, the biology-- We start learning biology from-- We learn a little bit at the early grades like fifth, sixth, seventh, but the real biology with difficult terminologies, which I hated--even now I cannot handle them-- starts from ninth grade very seriously. There were thick books from ninth grade for three years. And those books were so poorly written. It was hard for me to grow an interest. On the other hand, my father was hoping that I would grow an interest in biology. I did not at that time. Absolutely, in reading those books, I could not imagine that I would become a doctor or a physician. On the other hand, physics and math, those were the subjects I loved at that time. I couldn't imagine that I would not do those but study this for the next five years. It was just like a nightmare.

MAESTREJUAN: Were you sneaking in and reading or doing problems out of your physics and math books while your father was bringing home more medical-oriented books?

RAYCHAUDHURI: My father never-- What he never did was push me on an everyday basis. It was when the exam time, whether I am studying biology or not-- So I had a lot of freedom that way. It was only when I had to take an exam that decided whether I would go to medical school or not, that's when he was pushing me.

MAESTREJUAN: And you were about sixteen or seventeen years old when you had to take these exams?

RAYCHAUDHURI: You're right, absolutely.

MAESTREJUAN: Before that, say, in grammar school, did you always seem to be interested in math and physics or were you equally interested in, say, art or history at school or just playing cricket and soccer?

RAYCHAUDHURI: I played cricket, soccer, and then math. That's all.

MAESTREJUAN: In that order. [laughter]

RAYCHAUDHURI: I do not know why I did not grow an interest in history or geography, because now these subjects I like very much. Now when I see my daughter [Keya Raychaudhuri]'s books, when I realize that there's so many things that I do not know-- I would like to know. I would love to read a book and learn about history and geography.

It would have to do probably with the books or the association that I had. I had a tremendous interest in math. That was probably due to my grandfather [Surendra Bhattacharya], my mother [Arati Raychaudhuri] 's father, who used to live with us in Calcutta. You know, my mother used to be the only daughter. They used to live in a different part, and when my mother got married they basically couldn't stay away from her. And it was easy for my father to have them around. That's probably the reason that my mother could have that many children. [laughs]

My grandfather used to buy books on mathematical puzzles, and he would spend a lot of time with me trying to solve those puzzles. He would not start from-- They were like arithmetic puzzles, starting from one and going up to ten in the chapter, one being the easiest and ten being the most difficult. What he would do was start from ten and sit down and think, trying to solve the puzzle. I was like a five-year-old boy at the time--yeah, five, six--and I used to be very fond of him. As a result, what I used to do and what he basically challenged me to do was solve some of those difficult ones. I don't remember how many I did, but I grew a knack of solving difficult problems.

That kind of stayed with me throughout school. You know, the next fifteen-- Throughout school. I loved math. There was no problem that I could not solve at that time. I was famous for that. If there's a difficult problem, no one can solve it, come to me and get it done. I was very poor in other subjects. [laughs] I had no time for the subjects that I could not relate to, and I feel bad about those things. I think that if the books were written better or presented in a different

way, I probably would have liked many other subjects.

MAESTREJUAN: Well, did you work out a deal with your fellow students that you would do their math problems if they would do your language or history papers?

RAYCHAUDHURI: It never worked that way. You know, these exams are different, the styles are different. You go to an exam, you answer essay-type questions all the time. Your grades depend on how well you answer those questions, so no one can help you.

MAESTREJUAN: Were your teachers in school ever identifying any particular interests or abilities in you?

RAYCHAUDHURI: Yes, obviously the math teacher was very fond of me because I used to do very well in math. In a later part after ninth grade I started seeing the physics teacher. There was one science subject till eighth grade, and then in ninth grade you started seeing physics books, chemistry books, and then other several mathematics books. At that time all the science teachers started liking me. I think the knack in mathematics helped me understand physics probably. It was kind of an easier subject for me. Chemistry I liked probably because it involved a lab, it involved test tubes, it involved changing colors. So those things were actually quite interesting to me at that point.

MAESTREJUAN: And how were your teachers at those levels?

RAYCHAUDHURI: The science teachers were actually fantastic. There were very good science and math teachers in the school I went to. They were very good in what they used to do. I would compare [them to] any good teacher in this country, the way they would explain things, the time they would spend with students. I still think that [compared] to some of the teachers I have seen in college and then after college, I learned more from those school teachers in terms of how to think, how to solve a problem, and things like that.

MAESTREJUAN: To go a little bit back to your grandparents, did your grandfather have any formal education? What did he do?

RAYCHAUDHURI: He used to be a physician, but this is not-- What do you call them? You know, they use herbals [ayurvedic] to treat patients. There is a name for it. It's not homeopathy, it's-- I can't recall. So he used to treat patients.

MAESTREJUAN: Osteopathic?

RAYCHAUDHURI: No, probably there is no English name for it. You can compare, there are physicians in this country that use herbals to treat patients. They have herbal drugs and leaves, they will make medicines.

MAESTREJUAN: Herbalists? Not a homeopathy? It wouldn't be described as homeopathy?

RAYCHAUDHURI Well, no, not a homeopathy. It's clearly different from-- It's of totally Indian origin. I do not recall his education, how far he studied or anything. I was never interested to find out either. In fact, he died when I was still in school.

MAESTREJUAN: So if you got sick, how were you treated? With your father being a pharmacist and--

RAYCHAUDHURI: That was very clear. My father was very strong about that. I was given antibiotics. [laughs]

MAESTREJUAN: Basically traditional Western kinds of medicine.

RAYCHAUDHURI: Right.

MAESTREJUAN: What about your grandparents on your father's side? Did you have much contact with them?

RAYCHAUDHURI: No, actually very little contact with them, although they used to visit us. They never made an impression on me. My grandfather [Kunja Behari Raychaudhuri] lived for 112 years. He was thin. He used to walk like five miles a day at an age of a hundred. [laughs] I had never seen him suffering from any diseases, except for one minor car accident he had. They were very healthy individuals. They had a fun life. I can tell you about their stories.

MAESTREJUAN: Certainly. I find that interesting.

RAYCHAUDHURI: My grandfather used to be a landlord. He used to be in the country you know as Bangladesh now. Back then it used to be part of India. It used to be one Bengal, so the state I grew up in India is called West Bengal and the other part is East Bengal [now Bangladesh]. They still speak the same language. So my grandfather used to be a landlord and was a very rich person. There are stories about him that people talk about that I do not know how real those are. For example, he would go to take an exam and take an elephant ride to go to the exam hall. [laughs]

MAESTREJUAN: Just to make a grand entrance?

RAYCHAUDHURI: Right. I saw him quite a bit, but he never showed an interest in-- In fact, we never had any significant interactions, although he was very close to my father. My father was very close to him. I probably never had time for him. Maybe I was busy. Unlike my maternal grandfather, who had, I think, a lot of influence on me. I still think that a lot of my scientific ability--the ability to think and the ability to solve a problem--probably came from associations with him.

MAESTREJUAN: Given that he practiced perhaps a different kind of science than your father?

RAYCHAUDHURI: No, not that. He stopped practicing when he started living with us. He used to basically take care of us. It's the fact that he used to do math with me. The level of math he used to do at that point-- When I was like in first grade, he would try the math of fifth grade on me, try and challenge me to solve that.

MAESTREJUAN: So in terms of your education in math, you were probably getting a better education at home than you were at school.

RAYCHAUDHURI: Yes, absolutely. At least in those earlier grades of school. He died when I was in tenth grade, I guess.

MAESTREJUAN: Did it help that your other grandfather, if he showed up on an elephant to his exams, did that help him pass his exams?

RAYCHAUDHURI: Well, there are those stories about those things, and I do not know how true they are. [laughs] I do not want you to record all those things. [tape recorder off]

MAESTREJUAN: From what little history of India that I know, particularly being a European, India is an interesting place for me because it was forced under the colonial period to be very westernized, and its science to this day is very advanced relative to other westernized nations. But it also has its own traditional culture. What kind of values, both in terms of traditional Indian values and religious values, did your parents instill in you, given that your father clearly, being a pharmacist, was very much towards the Western scientific tradition.

RAYCHAUDHURI: That's true, but my father is also a very religious person. If I start talking about it, it's going to be a big story.

MAESTREJUAN: That's okay.

RAYCHAUDHURI: We are Hindus by religion. In India there are several big-- I don't know how to describe this. There are famous priests who are respected by a massive number of people. My father was associated with someone [Swami Swarupananda] who he regarded as a prophet.

MAESTREJUAN: A prophet?

RAYCHAUDHURI: That's what my father would call him, but this person never-- In fact, he banned his disciples from calling him that. My father had a strong association with this person and he made sure that all his children associated with this person. I used to visit and see this person like once a week, as you go here to church on Sunday morning. We used to go in and visit this person, and there's prayer. And we used to do that. And I have done that since I was--what?--a few years old. I had read a lot of books written by Swarupananda. These are on philosophy mainly, Hindu philosophy. They are related very much to Buddhism. If you think of what are the basic facts in these, you find that they are pretty similar to Buddhism. Hinduism, Buddhism--there are a lot of similarities at the very basic level, but then they diverge a lot depending on how people interpret it and things.

So I have actually grown an interest in religion because of this association and my father's interest in religion. At many times I have read--I still read--books on religion and philosophy. I try to understand them because science is totally like an opposite thing from what many religions preach. There are people who are well-respected Hindu philosophers. They're, again, like this person [Swarupananda]. Being a scientist I can relate to them more than I can relate to someone who is a Catholic priest, because of how broad-minded they were in terms of thinking what God is and how far science is from God. Some of them are actually quite broad-minded and you can relate to them, being a scientist, more easily.

MAESTREJUAN: In what ways?

RAYCHAUDHURI: In the way they define God.

MAESTREJUAN: And how would you--? It's obvious that you still think about these issues. How do you--?

RAYCHAUDHURI: I'm confused.

MAESTREJUAN: Aren't we all. How do you relate to God, being a scientist but obviously being a religious person?

RAYCHAUDHURI: This person I was associated with because of my father, this person I was talking to, there were certain things he would say that would make a lot of sense. He would say that every human being you see is a part of God. He would respect every human being as a part of God. Sometimes it makes it difficult, because a bad person is also defined as a part of God. So that makes it difficult. Preachers of this theory do not distinguish between a bad person and a good person. To them they are all part of God. They treat them equally. For me to understand that every person is a part of God, to be able to respect everyone, I have no problem with that. I can handle that with exceptions. I can deal with that.

They say that the purpose of life--this is the difficult part--is to evolve and become a better human being. We die and then we are reborn and ultimately we develop to someone like a god. Some of these prophets, they say this is probably like their three hundredth life [laughs], so they have evolved to come to that point. So they're saying that this is simply an evolution process from a bad person to become a prophet--the same thing. So they do not distinguish. They just tell you the purpose of life is just to develop yourself. That's what they say. If you're looking for God, they say--just like Mother Teresa-- help people. If you are helping people then you are basically-- It is the same thing as praying to God. These are the kinds of things that I can appreciate and I have no problem with, being a scientist.

MAESTREJUAN: When one associated with a particular person, what did associate--? What does that mean to associate?

RAYCHAUDHURI: Well, you become a disciple.

MAESTREJUAN: Okay. So you go once a week and talk or pray or read?

RAYCHAUDHURI: Basically pray. Because it's a huge crowd, you do not get to talk. But some of the disciples he will like very much, so they have easier access to him.

MAESTREJUAN: And was your father one of these people who had easier access?

RAYCHAUDHURI: Right.

MAESTREJUAN: Was it at his home or was it at some kind of place of worship?

RAYCHAUDHURI: Yes, place of worship, what they call ashram. You know, more like a church kind of thing.

MAESTREJUAN: And do you continue to associate with a particular person now?

RAYCHAUDHURI: No, he died. He died when I was doing my Ph.D.

MAESTREJUAN: You don't associate with a different person now?

RAYCHAUDHURI: Well, there is someone in that ashram who inherited--who basically runs this. This is a sect-- This is a particular group of people that-- They basically have-- I'm probably going away from what you're--

MAESTREJUAN: No, not at all. Undoubtedly you're the first Indian and Hindu believer I've interviewed. But it's amazing the religious diversity, of course, in the Pew scholars because they come from all places. It certainly is an important issue when we're trying to understand the intellectual context of your lives. And this is certainly quite interesting.

RAYCHAUDHURI: Well, yeah, I find that some of the philosophy-- You know, doing science is my occupation. I cannot do anything other than doing science. This is the only thing I can do. I'm not good at--

MAESTREJUAN: And why is that?

RAYCHAUDHURI: I used to spend eighteen hours a day thinking science. I still spend sixteen, seventeen, eighteen hours a day thinking science. And when I have to do something outside that, I'm so bad at that. [laughs] I can't imagine doing something else. But religion is something that--

Because of my father, I must say that I was able to meet this person who I do consider a very respected person. I respect him a lot. I'm a quite educated person--I still think he knows a lot more than I can ever learn in several lifetimes. This person wrote books, and those books I still read now, and I can see the kind of things he's saying and explaining. They all make sense, and you can explain it. So I was fortunate in that way, that I was associated with that person. That's why maybe I had grown an interest in religion.

I have read a lot of religious books and I still read them. Obviously there's something there. It cannot be a total fake. There's something definitely there. How far I can understand that, how far I can- - Obviously I am not spending any significant effort trying to learn them, but I would like to learn. When I have time, I would like to learn about it definitely.

[END OF TAPE 1, SIDE 1]

MAESTREJUAN: This probably seems like we're going off on a tangent, but I do find it interesting, particularly as a historian of science, but also because I have interviewed other Pew scholars who feel this ambivalent attitude. American science or even, you could argue, Western science from the nineteenth century has really struggled with this rational reason side versus this religious side. Science somehow was supposed to replace religion as a belief system in the Western world--Europe and the United States--and it never quite has, as historians might argue and they do argue. Yet it's clear that scientists themselves struggle with these issues. They have to be a little ambivalent. "Can I be a rational scientist and can I struggle with these more metaphysical questions of religion?"

If it's okay, could I ask a couple of more questions on this area? One is, do you maintain any kind of contact with your religious community in India and have you created a new community, whether in New York when you were going to school there or Duke or here now in Chicago, with a Hindu religious community or perhaps even just an Indian cultural community?

RAYCHAUDHURI: Cultural community, yes. But not religious community. That I did not find time for at all. The cultural community, I started going there because of my daughter. I thought she needed to know a little bit. For example, tonight I am going to take her to one place. In India there are Hindu systems where they worship gods and goddesses. It's about this time they worship the goddess Kali. So there is a cultural program today that I am planning to take her to in the afternoon.

MAESTREJUAN: Why do you think it's important for her to have this contact?

RAYCHAUDHURI: Well, she needs to know. If she does not know now, then she will never know it. So that's the only purpose I have to do this. Basically I do very little. I go there like three times a year. It's very minimal compared to other people.

MAESTREJUAN: In comparison to your father's encouragement to associate with a particular person, to read about things, to kind of explore religious issues, have you tried to encourage your daughter in the same way to be interested in these kinds of questions?

RAYCHAUDHURI: I am trying. I just started. You know, she's nine. She used to go to a Catholic school, and so she learned quite a bit about Jesus. I thought maybe this is time that she also learned about other religions, and so I just started to teach her a little bit, tell her stories about these things. I just started that. I think that she ought to know about all the religions, and the one that I know very well she should know too.

MAESTREJUAN: Is her mother also Indian or Hindu?

RAYCHAUDHURI: Yes.

MAESTREJUAN: Why was she going to Catholic school?

RAYCHAUDHURI: Well, it's a good school. There's no other reason. It's a good school in Oak Park, and we heard that the first-grade, second-grade teachers are very good. That was the only reason.

MAESTREJUAN: It's like a private school.

RAYCHAUDHURI: It's a private school. It is.

MAESTREJUAN: To go back, you had mentioned it's kind of funny because here's science on one side and religious beliefs on the other side, and you seemed to indicate that there were these two poles. How do you see this issue? Are there two poles called science and religious ideas or

religious philosophies, and how do you reconcile those two?

RAYCHAUDHURI: Well, you know, the two poles is something that you hear a lot. But the kinds of things that I tend to focus on, they tend to make these two poles fuzzy. That's why I get confused. For example, this person I was talking to—Plus there are other Hindus whose preachings do not disregard advances in science. They talk about things and none of those things go against anything we do in science. In fact, what I tend to do is read more of those because I can easily communicate with those ideas. So I find the Hindu religion as explained by some of these people as quite acceptable to a scientist. And I find that they are not against what we do. Because of the breadth of their thinking, everything is acceptable to them. There are some basic things that they want you to do. As long as you're doing it, they do not find fault with everything.

That has probably made the religion look bad, because it doesn't tell you in a simple way what is good and what is bad. There were some people who tried to help it. They said, "You have to develop yourself." The question is "What is yourself?" You do not know most of the time what is yourself. Then some people started saying you have to build your character. That became easier, and that became more like the Catholic: do not do the bad things because that makes your character bad. The Hindu religious books I read and things I think about, they do not have problems with science.

MAESTREJUAN: I interviewed recently a very strong Catholic scholar who believed strongly in the Catholic religion. I asked, "What about the issue of cloning?" now that Dolly has been sprung upon the world and we have these big fears in the Catholic Church coming down. And here's a scientist who's working strictly with transgenic mice, right? So of course the interesting question is when you believe so strongly in one set of beliefs and that hierarchy or institution that promotes those beliefs is saying you shouldn't be doing what you are doing, how do you reconcile that? And what it seems to me you're saying is that your religious beliefs are actually very harmonious with science.

RAYCHAUDHURI: Yes. As I said, my religion believes in evolution. They believe in it, so no problem with Darwin's theories. As a result I do not have problems. Again, you might find it different when you talk to another Indian Hindu person, because this religion is so diverse. The interpretation could be so different. You might be talking to a person with a totally different idea.

MAESTREJUAN: Well, this is really fascinating. We can go back then to your father's expectations. Obviously this is probably one area that you didn't conflict with him, but we do know that he wanted you to go to medical school. When you were thinking about what you wanted to do with your life, say, when you were thirteen or fourteen and you had to think about these things and you really enjoyed math and physics, what were you thinking about doing in

terms of what you wanted to be when you grew up?

RAYCHAUDHURI: A scientist was always-- For some reason it was really attractive to my sisters as well as to me. I do not remember why that was so. It was actually a lot of things. The chemistry, the chemistry lab, mixing things--that I found very interesting. At that point I thought that's what scientists do, and that's probably why I wanted to become a scientist.

MAESTREJUAN: I always ask this question because it's not an easy one, but sometimes it's interesting to explore. What does it mean to be a scientist when you're fourteen or fifteen? Because many Pew scholars say, "I wanted to be a scientist." At that point, if you can remember back, what did you think you would be doing? What did a scientist do, as opposed to being a fireman who puts out fires?

RAYCHAUDHURI: My feeling was that, at least in India, a good scientist earns a lot of fame. [laughter] So it was probably that. Maybe I thought it would be the appropriate profession for me, discovering new things. Discovering new things always fascinated me. When I read stories about scientists, those were always fascinating. Maybe some of those got stuck in me, and maybe that's why I didn't go for any professional studies. I wanted to study more science and do research. It was probably reading stories about scientists.

MAESTREJUAN: Were there any particular stories or books that you read, or scientists that you saw as being your role model?

RAYCHAUDHURI: Yeah, there were quite a few actually; not just one. There was a physicist in Calcutta. His name is [Satyendra N.] Bose. He became associated with Einstein. He discovered a particle, one of those tiny particles in physics. It's called boson [particle]. He collaborated with Einstein at that point. He was impressive. He became famous in Calcutta because of his association with Einstein. It was easy for you to get to read about him. Even though you're not trying to, you got to know about those things. There were a few other people in Calcutta who our physics teacher, chemistry teacher would talk a lot about. It was basically their lives. Probably those things played a role in making a decision to become a scientist.

MAESTREJUAN: You explained that there was the fame factor in becoming a scientist. What about the fortune factor? How did that translate? Particularly in India, in terms of being a physician, you can go out and get a job and probably earn a decent--

RAYCHAUDHURI: Absolutely. I never had-- Even now I do not really go for a lot of money. I am not that-- I like a comfortable living. [laughter]

MAESTREJUAN: Don't we all?

RAYCHAUDHURI: I like to have that. And then I can be happy easily. So fortune never attracted me. Fame was much more attractive.

MAESTREJUAN: When it came time to take the exam to go to medical school, how did you reconcile this issue with your father? Obviously this was a source of conflict, so how did you resolve this conflict?

RAYCHAUDHURI: Well, it was not a problem for me. It was kind of easy for me to flunk in biology. [laughter] You have to take physics, chemistry, and biology. I do extremely well in physics and chemistry, but I do so poorly in biology that I probably would not be picked to go to medical school. So he had no choice basically. [laughter]

MAESTREJUAN: And was this a conscious effort on your part?

RAYCHAUDHURI: Yeah, it could have been that way too. I was not interested. I did not study. In fact, cutting open a body was not attractive to me at that point. I avoided it as much as I could. [tape recorder off]

MAESTREJUAN: In terms of how well you did in school, how would you describe your overall grades?

RAYCHAUDHURI: I was not the outstanding student in class. There were better students in the class--"better" meaning they would perform much better than me in exams. The type of exams there, as I said, were essay-type exams, and I was never good at that at that point. I was among the top ten, but I was never the top person. So I did quite well. I was admitted to the best college in Calcutta. So, as I said, I was not outstanding in exams and in performance, but I could do well enough to get into a good place.

MAESTREJUAN: How did your father react to all of this?

RAYCHAUDHURI: He was upset.

MAESTREJUAN: Upset?

RAYCHAUDHURI: Yes. The fact that I didn't get into medical school. Also, he talked about if I'm not getting into medical school I'd probably go to engineering school. But then he was not very serious about the engineering school because he had a friend who never respected any engineers. So it was kind of easy for me to avoid engineering and then get into general education and science.

MAESTREJUAN: What was your idea, in terms of knowing that you have this really strong ability in chemistry and math and physics, of what kind of courses you would be studying and maybe what profession you would choose?

RAYCHAUDHURI: I was not sure at that point. In fact, it was more like learn and find out what would be more appropriate for me. In India you go to college for three years, not four years. After that you get your master's. It is then you-- For example, I had a major in chemistry, so I learned a lot of chemistry. I learned organic chemistry, inorganic chemistry, basically all types of chemistry, but I did not specialize in any one of those. It is after college that you specialize and determine which way you want to go. At that point the science and the research becomes very important. Depending on what you are going to pick, your life is going to end up that way. It was at that point I talked with several college professors. I told them I wanted to do science and research, and I was basically taking advice from them. They told me that biochemistry would be the appropriate thing for me to do because there are a lot of research opportunities in this country for students who are trained in biochemistry in India. They gave me a lot of examples, and I could see those people. It was basically at that point I was kind of committed towards a research career.

MAESTREJUAN: How quickly did this happen once you started at the university?

RAYCHAUDHURI: Well, I would say I was just counting my days there. I took my GRE [Graduate Record Examination] right after college. While I was studying biochemistry I was just-- I was told that you will need to do two years of postgraduate studies. That way you'd become equivalent to graduate students in this country. I was accepted at several universities here. I was not interested to join a Ph.D. program in India because the level of research that I could see while I was doing my master's there was not interesting to me and not good at all.

The unfortunate thing in India's studies and general education is that the school education you learn like this [indicates exponential growth with finger]. In college it goes like this [indicates arithmetic growth with finger]. But after that it kind of starts [indicates no growth with finger]. You don't learn any more. People who are doing Ph.D.'s, I would imagine they are

going down, unfortunately, because they do very little and they don't learn anything. That I realized very early, and I knew that even though I wanted to do science I would do science only if I could do it in this country. I would not do science in that country because the quality is so poor, at least in those subjects, biochemistry.

MAESTREJUAN: How were you able to make this assessment, that it was just so poor as opposed to what was going on in the United States?

RAYCHAUDHURI: Well, the visitors from here, they go there and give seminars, and you can tell the difference.

MAESTREJUAN: When they were talking to you about opportunities, what kind of opportunities were available to students who came from India here in this country? More specifically, was it graduate school? Was it jobs?

RAYCHAUDHURI: No, it was just the graduate school. I was told that if I get into a Ph.D. program here, then I would be able to do good science. That was the purpose and that still is my purpose, to be able to do good science. The job just allows me to stay [laughs], allows me to do that.

MAESTREJUAN: Well, what about going to another country? I mean, probably the obvious choice in India would be to go to Britain or perhaps Europe, France.

RAYCHAUDHURI: When I started learning biochemistry, it became very easy for me to find out where the good sciences were happening and where to go. That was not a problem at all. Biological science is much better in this country than in any other country in the world.

MAESTREJUAN: How do you explain the transformation that you didn't do very well in biology when it came time to take the exams for medical school, but then when you did explore chemistry you chose to go into more biologically oriented chemistry as opposed to organic chemistry or another branch of chemistry?

RAYCHAUDHURI: You're right, and I had a problem that time trying to accept the fact that I would be doing a little bit of biology, I would have to read those books. But I was told that if I wanted to do science, that would be the most appropriate thing to study because there is a lot of science to be done in that area. That was explained by my college professors.

MAESTREJUAN: Why did you have a hard time accepting--?

RAYCHAUDHURI: I had this mind-set. It was like a wall: do not do this subject; I won't be able to get interested.

MAESTREJUAN: Was this more of a mental barrier that you would have to overcome?

RAYCHAUDHURI: It was mental.

MAESTREJUAN: Or was it part of the educational differences between, say, the university education of biology and your secondary education of biology?

RAYCHAUDHURI: I did not take any biology in college. I left biology in school and was a happy person. [laughter] So it was not college education, definitely. I was convinced that if I wanted to do science, then that is something that I had to learn a little bit. So it was more like a mental barrier that I had to overcome. The transition was not bad at all. Biochemistry is different from-- There were others, like physiology. This is something where you learn about those big words which still [laughter]-- Anatomy, that's where you learn all those. Biochemistry is different from those. So it was not bad.

MAESTREJUAN: We'll probably come back to this when we talk about your work now. But at the time, when they were saying, "Well, if you want to do good science you need to do biochemistry," what was the connection between biochemistry and good science? What at that point did you think was a good topic? Did you have any laboratory experience or any sense of what is a good topic in biochemistry or what is good science in biochemistry?

RAYCHAUDHURI: No, at that time I did not have any idea on biochemistry because I did not learn any biochemistry at that time. Although now they have changed courses; now the students learn. We did not learn any biochemistry. I had no idea what biochemistry is. When I was told that I should consider this very seriously, in fact I borrowed a book or bought a book--I don't remember what I did, but I definitely brought a book home—and looked at it to see whether that is something I should be able to do. Probably I was just trying to overcome the barrier ahead about biology. It was not repelling to me at all, the book I borrowed. I think it was a book [Principles of Biochemistry] written by [Albert L.] Lehninger, and it read so well compared to some of the chemistry books that I was used to reading that I became interested. I thought I should be able to like it.

After getting into the biochemistry program, there were one or two good teachers there who would point out problems that needed to be solved. It was at that point after I entered the biochemistry program I developed an interest and I sort of knew what I wanted to do. Obviously cancer was interesting. I basically learned about cancer back in India in fact, what the problem is--not the disease, but the biochemistry. At that point I sort of knew that I would be doing cancer research, and in fact I stayed with it. I still do it.

MAESTREJUAN: What was it about the cancer research that was attracting your attention?

RAYCHAUDHURI: It was the fact that it was defined as a problem that cannot be solved, which always fascinated me.

MAESTREJUAN: So it's this intellectual thing. If they say "Okay, Pradip, you cannot solve this problem," you're going to solve it.

RAYCHAUDHURI: Right. Well, that was the idea, that this is the hardest problem known to mankind, solving the cancer problem. That was the attraction.

MAESTREJUAN: So cancer for you had nothing to do with the anatomy and all the other medical kinds of things?

RAYCHAUDHURI: No, no.

MAESTREJUAN: While you were going to the university, were you living at home?

RAYCHAUDHURI: Yes. They were actually pretty close to my home, within walking distance. As I said, I was in the center of Calcutta, so things were pretty close.

MAESTREJUAN: In terms of a traditional university student's life, did most of them live at home and go to the university?

RAYCHAUDHURI: Yes. Well, the people who are coming from outside the city or from a distant part, there are dorm[itorie]s for them. That's where they live. There's actually a limited number of rooms that are available, so often I know many students they have to travel a lot every day just to get to college or university. They have to travel like an hour and a half.

Because the dorms are cheap. Probably they don't pay anything.

The education is very cheap in India, unlike this country. College, you know, you pay nothing, almost nothing. College and universities, it's like free. The tuition is almost nothing. If I mentioned, you'd probably laugh at me. For a year, you'd probably pay something like $10.

MAESTREJUAN: It's DM 60 in Germany for one semester, and that translates right now to about $40. And that's at a public university system. I don't know what it is here at the University of Illinois, but at the University of California it has gone up to $1,800 a quarter, which is quite expensive if we're a state-run school. It's amazing.

Had you given any thought to going to a university other than the University of Calcutta? Was that an issue?

RAYCHAUDHURI: That was not an issue because that's basically the main university in Calcutta. It is like the British system. It's like going to Cambridge. There is one university, but then there are many branches. But you get your diploma from one place.

MAESTREJUAN: To go back a little bit to the chronology, you finished your first degree in three years, and you took the GRE in the year following that.

RAYCHAUDHURI: That's right.

MAESTREJUAN: What were you doing in this time after college but before going to a graduate program in the United States?

RAYCHAUDHURI: As I said, I was doing this biochemistry program which is a postgraduate study. Two years. They give you a master's degree. That's what I was doing.

MAESTREJUAN: Okay. And when it came time to decide what university you were going to go to in the United States, with this plethora of universities in the United States, how does one go about deciding?

RAYCHAUDHURI: I was told that based on my GRE I would not be accepted into Harvard [University], but I would be accepted in a reasonable place. The application fees were just like now, and it was not easy for me to get twenty applications sent out because $25 is a lot of money at this point for me. I did apply to, I remember, six or eight, but then I got responses

from three of them immediately. One of them was UCLA. Yes, UCLA. Yeah, one of them was UCLA. But I picked Einstein. The name had a lot to do, probably. From India, you do not know the difference between this and that. The information is not there all the time.

I had seen people from Albert Einstein going there, visiting there, and giving seminars, so I knew about Albert Einstein. And back then Albert Einstein used to be a very good research institute. It still probably is, but then it was quite good. Like every department had a National Academy [of Sciences of the United States of America] member. Also the person I did my graduate studies with [Umadas Maitra] , he's an Indian. He visited and gave seminars which I liked. He was quite impressive. You know, coming from India to the United States, the consideration was I was offered by two Americans and an Indian. I didn't know the Americans. I knew them by name, but this person, I had seen him giving seminars, so it was kind of easy for me to-- Also my parents thought that it would be easier for me if I came here. My mother was not happy at all with my leaving the country. She was thinking when am I going to come back.

MAESTREJUAN: She hasn't had much of a voice here yet. How much did she influence the directions you've taken?

RAYCHAUDHURI: She had little. In fact, my father had more.

MAESTREJUAN: When you were getting ready to leave to go to the United States, where were your thoughts about how long you would be in the United States? What would be your future in India? I mean, your future plans, did they include returning to India at some point?

RAYCHAUDHURI: Oh, yes. My thinking was to finish my Ph.D. and try to get a job in India. There were good research institutes where I could find a job. It was the intention then. It has changed now.

MAESTREJUAN: A job in an academic setting?

RAYCHAUDHURI: Yes.

MAESTREJUAN: Or an industrial environment?

RAYCHAUDHURI: Not industry. It never attracted me at all.

MAESTREJUAN: How were you going to deal with the financial issue of going to college in the United States?

RAYCHAUDHURI: That was not a problem. I was offered a scholarship.

MAESTREJUAN: Had you given serious consideration, besides perhaps UCLA, to any of the other schools you applied to?

RAYCHAUDHURI: In fact I quickly got offers from three places: UCLA and Oak Ridge National Laboratory and this place. I just was happy, and I thought any one of these would be fine. And then Einstein and this Indian person and talking to other people, many of them thought I was really lucky that this Indian person is there and I am accepted there and if I go there that will be a good Ph.D. program. I don't complain, even though-- I think I learned a lot from this person.

MAESTREJUAN: Well, Oak Ridge, Tennessee is a far cry from New York City, I can imagine. How much traveling had you done to the United States or even outside of India before you came over to the United States? Had you had any experiences here?

RAYCHAUDHURI: No. In fact, I did not travel at all. My mother would not let me go out very much, so in fact I traveled very little.

MAESTREJUAN: What was your image of the United States or, perhaps being a fairly broad place, of New York and New York City?

RAYCHAUDHURI: I do not recall those. Seriously, I don't recall. Obviously I was scared, because I was never away from my home. The only thing I remember is after coming here it was very painful for me the first six months, extremely painful for me to stay away from my family. I used to look up and look at planes: "How can I go back?" I didn't have money to go back. [laughs]

MAESTREJUAN: I was going to say, what kept you here? The money will do it every time. I noticed on your CV that you got a master's, and it said at Albert Einstein. Was your original goal to get a terminal master's degree?

RAYCHAUDHURI: No, that's just New York. What New York does is if the schools there

give out a diploma, they get $500. [laughs] So in New York, because we take prelim[inary] exams, they give out a diploma which costs them--I don't know--a dollar or two, and they get a $500 profit from the state. So most Ph.D.'s from Einstein, they have a master's.

MAESTREJUAN: I see. I didn't realize that. So your idea the entire time was to get a Ph.D.

RAYCHAUDHURI: Right. The department I went to, studies for master's is like secondary to everything.

[END OF TAPE 1, SIDE 2]

MAESTREJUAN: When you arrived, how was the program at [Albert] Einstein [College of Medicine of Yeshiva University] structured for, say, your first year or two in terms of course work and lab bench time?

RAYCHAUDHURI: I was in the top department in that school there. The philosophy of the department is to prove yourself by doing new things. Course work you do in between your experiments. You study for your course work in between your experiments. Your experiments cannot suffer for those things; those things are not important at all. So it used to be a very tough place. The course work was very hard. In fact I remember among the twenty students only two of us passed the courses in one shot. So it was tough. But then we were not allowed to have time to study. We had to do experiments; doing experiments was primary.

That, in fact, I enjoyed very much because that was my interest and I liked to work. I used to spend quite a bit of time in the lab. Between course work and research I spent like 80 percent of my effort in the first two years in doing research and 20 percent in course work. Fortunately, I managed to pass doing that. And that's what they expected. In that department I was recruited, that department had a very high standard of students. Some of them are Pew scholars. There's Stewart [H.] Shuman. I don't know if you-- Some in UCLA also. It used to be a very high-standard department, and again, you had to prove yourself. You had to give seminars, and that's where you prove yourself and you show that you have done something new. The seminars there, the senior students, postdoc[toral fellow]s, and professors, they basically tear you apart if you are doing a poor job. There's no mercy. There's no mercy. So it was a very tough environment. It was challenging to me. I was just completely occupied by those things.

MAESTREJUAN: How did that affect the relationships, the interactions, between students in this program that kind of fostered "Okay, you have to do your best all the time" and they weren't going to show any mercy in your presentations?

RAYCHAUDHURI: Often students get basically kicked out of the department. They are just told they are not going to make it in this department. It was a department for arrogant people who were tough and who could do things. Basically, that was the environment. It was a very tough place.

MAESTREJUAN: Was there a lot of competition between students?

RAYCHAUDHURI: Yes. Well, the research projects were different. The competition was on doing new things that would impress the department head. See, that department, although I worked for this Indian professor, was run basically by one person who used to be the chairman. All the professors were his students at one point. This is probably more like the German style. It was like a one family kind of thing. It doesn't exist that way anymore there, but it used to be like that.

MAESTREJUAN: What happened?

RAYCHAUDHURI: Well, the chairman moved to [Memorial] Sloan-Kettering [Cancer Center].

MAESTREJUAN: How well did you feel your education in India prepared you, both in terms of just the content of what you had learned, but also in basic laboratory techniques? How well did it prepare you?

RAYCHAUDHURI: Textbook-wise, I was fine. I had no problem. As I said, just spending 20 percent of my time I could pass the exams very well with no problem, some of them with a perfect score because I learned many of those things in India. But lab work, very little. That's why I had to learn a lot from senior students. The senior students were not-- Again, there was no mercy. [laughter] A merciless department. They insulted, really. If you do one thing poorly, you will get insulted. I guess the fear of being insulted [laughs], that helped me learn things quicker.

MAESTREJUAN: This does not sound like an environment of positive reinforcement.

RAYCHAUDHURI: No. That department selects for strong pupils only. Someone who is mediocre will not be encouraged to do science. That's the way I see it now.

MAESTREJUAN: The work you did after you graduated from the University of Calcutta in this master's program, how much actual bench work did you do before you got to Einstein?

RAYCHAUDHURI: Very little. The kind of bench work I did was negligible.

MAESTREJUAN: Okay. So basically when you got to Einstein they were teaching you how to use a pipette and run a gel?

RAYCHAUDHURI: Run a gel, yes. Pipetting I learned in Calcutta, in chemistry lab. I would say I had very little bench experience before coming here.

MAESTREJUAN: When you arrived at Einstein, had you already made the decision to work with [Umadas] Maitra in his lab?

RAYCHAUDHURI: You're right. That sort of was the intention of coming to Einstein. Plus the fact was that department at that time was the best department in that school.

MAESTREJUAN: Where was his research program at this point in terms of what his lab was doing in mechanisms of protein synthesis? I guess I'm just asking, how did you go about working on the project you did?

RAYCHAUDHURI: Actually scientists in that department at that point were studying some of the basic things in biochemistry. Those people were a bunch of biochemists, and I could easily relate to them. Some of them were working on DNA synthesis, some of them were studying RNA synthesis, and Maitra was working on protein synthesis. All these were macromolecule synthesis. That involved learning a lot of enzymology, and basically the same kind of technology was being used by everybody on the floor. They were basically enzymologists. They purified proteins but studied different biochemical reactions.

Maitra, at that point, finished studying bacterial protein synthesis, and he started studying mammalian protein synthesis. And that's where I got involved in his lab, studying the initiation part of protein synthesis. Like macromolecule synthesis, there are three main steps. There's a lag phase called initiation phase and then elongation and then termination. The initiation part was the interest in that lab.

MAESTREJUAN: Before this point, had you given any thought as to even what kind of models you wanted to look at, whether it was procaryotic or eucaryotic or mouse or fly or yeast?

RAYCHAUDHURI: In fact, I did not. I knew that at some point I wanted to do cancer research. That I knew. The name of the department was, at that point, [Department of] Developmental Biology and Cancer, so I thought, "If I go to that department, I'll learn a lot about cancer." That's all I knew and cared for at that point when I came in. I didn't care about what specifically I was studying at that point.

MAESTREJUAN: Now to get back to this question again, it seems to me that here's a reluctant biochemist at best. They said, "Well, a good science is biochemistry," but at that point you really didn't have any idea about what is biochemistry. But you go into this lab which, in looking at protein synthesis, is clearly at the heart of biochemistry. How did you transition from reluctant biochemist to now being interested in a lab that had a fundamental biochemical problem?

RAYCHAUDHURI: What probably helped is the fact that I came to a totally different country. Everything is changed, everything is different, and I learned to accept almost everything that I was reluctant to accept that easily. That might have helped. There were senior students, in fact, from India, who I knew as very good students. I talked to them. At the early stage, one or two senior students helped me or played a role in getting into things in that lab.

MAESTREJUAN: More specifically, how did you become integrated into the lab?

RAYCHAUDHURI: You know, it was the fear. [laughter] It was fear for survival. As I said, this department was such that you had to become a very aggressive person. My English was very poor at that time. You would not imagine that I would not understand like 80 percent of what you're saying. It was that bad because I had not spoken to an American. The American accents are somewhat different. The only exposure I had were the movies. So it was a huge challenge for me. Plus this fact that I needed to survive in that department or I'd get kicked out of the department and then go to another department which is considered to be a lot less.

This department had a bunch of arrogant people who were good scientists, and there's no question about it. They would tell you, clearly in your face, that to be able to survive you have to publish papers in good journals. So it was the survival in that department that probably-- And probably my ability a little bit. I must say that I was tough. I had a lot of interest to learn things, and so I could learn things. I started learning the language. It is different for someone who's coming from a totally different country, especially to a department like that, to survive. You know, I know this university. I've seen other universities after that. I've seen Rockefeller [University]. I've seen Duke [University]. But I still think that that department there at Einstein, at that point, was one of a kind.

MAESTREJUAN: How did this translate into what you did with your time? Were you in the lab twenty-two out of twenty-four hours a day? How did you compensate for the lack of language skills?

RAYCHAUDHURI: It was the time I needed to put in. I used to work until one thirty, two o'clock in the morning and go to bed at two o'clock and then get up at seven--so five hours of sleep--and then work. I used to work very hard. In fact, all the students in that department were like that. I mean, you would not see this, an empty lab. Never. I never saw an empty lab when I was a student in that department. It was the pressure. For me, it was from no pressure to like a hundred percent pressure situation and the fear of survival in that department. So those things played a role.

MAESTREJUAN: Well, it seems to have worked, because it seems to me that you had a very productive time in your lab.

RAYCHAUDHURI: Yes, yes. I was very productive, and I did very well. There was a lag for two, two and a half years, but after that I definitely picked up and I did very well.

MAESTREJUAN: And you ended up with--what is it--about six articles in *JBC* [*Journal of Biological Chemistry*]? In--what--three years?

RAYCHAUDHURI: Right.

MAESTREJUAN: And which actually could tell an interesting story, from what I can understand of it. What was driving the questions that you were working on at that point? You just talked about how different labs were working on DNA, RNA, and protein synthesis. For your work, were you looking at questions of basic mechanisms of protein synthesis and the key factors involved in the initiation process and creation of this initiation complex, or was it kind of larger issues of cell proliferation, cell development and growth in the cell cycle?

RAYCHAUDHURI: I hate to say this. At that point, we were mainly interested in the mechanisms. We were very narrow-minded, which I realized after finishing my Ph.D., that I was very narrow-minded. Yes, I spent a lot of time trying to learn, trying to develop new things, but asking a very narrow-minded question: What is involved in that one particular reaction? I definitely worked out that reaction, the details of it. But I did not think, at that point, about in the context of the cell or in the context of the whole animal how that reaction is important. The department was, as I said, made up of a bunch of enzymologists. They were more interested in

defining a new reaction. They were like that. It was only after I moved out of that place that I was exposed to more biology and broader things.

I realized that what I learned in my graduate school would be extremely-- When I started applying for postdocs, I was offered by whomever I applied to because I looked so good. They knew that the training I had at that point, enzymology, had a lot of value. Everybody wanted to do some of those. It was hard to find people who were trained like me at that point. I was offered by almost anybody I applied to. In fact, somebody offered me his parking space at Rockefeller University. [laughs]

MAESTREJUAN: Oh, wow. That's great, because I've been there, I know. And how were you identifying yourself? As you were finishing up and as you were publishing in these papers, *JBC*, how were you identifying yourself in terms of what your own work was about? Were you seeing yourself as an enzymologist or were you seeing yourself as a biochemist, and what did that mean? What did you think that meant?

RAYCHAUDHURI: You're right. That was a point I knew I had to change, because I did not want to continue that type of research. I felt that I had learned a lot. My interest was to do cancer research, and I wanted to get into cancer research. That became very clear that I needed to move on and do something which was more directly related to cancer research. So that's what I planned for and went for after that. I started studying virology, which is totally different from enzymology and biochemistry. I had to learn again everything from scratch. The techniques that I was going to use and the type of journals I was to read were totally different. So again there was like six months of learning. But I could do that. I could do it. I was fortunate that I could do it.

MAESTREJUAN: Well, one last set of questions before we move you off to the Rockefeller, and probably we're pretty close to a good stopping point for today. How well did you integrate into the Big Apple, socially and culturally into New York City, coming from Calcutta, India, knowing that for the first six months you stared at planes because you wanted to go back home?

RAYCHAUDHURI: I did very poorly. "Very poorly" meaning-- First of all, I didn't get time to do anything other than going to the city, Manhattan, and seeing movies. But then that was expensive, and the stipend was only $6,000 at that time. You couldn't do much, so you had to stay in the lab. You know, my friends were mostly Americans. I shared a room to Americans. I realized that if I stayed with my Indian community it might be bad for me. It may not be very helpful. [tape recorder off]

MAESTREJUAN: You were living with an American?

RAYCHAUDHURI: Right, yes. That was the only exposure I had with American culture--two medical students who were American. I had a lot of exposure to American culture from them. I started watching some of the comedy shows, Johnny Carson. I got introduced to that, which was very difficult for me to understand at that point. It took several years.

MAESTREJUAN: Humor is very difficult to understand if it's in a foreign language, I can attest. The Germans were always making jokes, and I couldn't--

RAYCHAUDHURI: Plus some of these comedians, you have to know quite a bit about American culture before you can understand the humor. And then the medical students, they changed, and then new roommates came in. That was the major exposure I had that I can think of.

MAESTREJUAN: Did you seek out any Indian communities?

RAYCHAUDHURI: No, except for when I knew that I could get a good dinner. [laughter]

MAESTREJUAN: Catch any [New York] Yankees games?

RAYCHAUDHURI: Fact is, baseball was not attractive.

MAESTREJUAN: Living in the Bronx?

RAYCHAUDHURI: [laughs] I could not get into baseball. I tried, I could not get in. I like football. I like basketball.

[END OF TAPE 2, SIDE 1]

[END OF INTERVIEW]

INTERVIEWEE: **Pradip Raychaudhuri**

INTERVIEWER: **Andrea R. Maestrejuan**

LOCATION: **University of Illinois at Chicago School of Medicine Chicago, Illinois**

DATE: **2 November 1997**

MAESTREJUAN: I'm not always quite sure I've got the accents on the last name right, but I know I'm doing the "C-H" part of it--pronouncing that right at least now. I wanted to start off today with several questions from yesterday's session. To start off I wanted to ask, did your father [Phani Bhusan Raychaudhuri] ever take you into his office or pharmacy and introduce you to chemistry or anything like that with his own profession?

RAYCHAUDHURI: Yes, a lot. In fact, in summer vacation I spent a lot of time with him--not after I finished school, before.

MAESTREJUAN: What did he let you do?

RAYCHAUDHURI: He let me watch. Often I helped him in doing things. I learned how to use the measuring cylinder and things like that. What is a cc [cubic centimeter], milliliter--things like that I learned from him, how to measure those things. I learned that it is important to be very accurate when you do things. It is at that stage, in fact, I learned that it is so important that when you are preparing medicine for patients you have to be following the protocol very accurately. So I spent quite a bit of time with him. At points I also helped him in doing things.

MAESTREJUAN: And how did you see this? Did you enjoy it? Did you see more health-related issues or more chemistry coming out of this?

RAYCHAUDHURI: It was more chemistry. I didn't understand the health part at all.

MAESTREJUAN: Okay. Of course he probably wanted you to understand the health part of it.

RAYCHAUDHURI: That was actually too early. I'm talking about when I was like, you know,

nine, ten years old or eleven years old.

MAESTREJUAN: We didn't talk about it too much. You talked about your grandparents, but did you have an extended family that you saw often in Calcutta--cousins, perhaps aunts and uncles?

RAYCHAUDHURI: Yes. My father had--I have to say had--seven brothers. I think two of them are still alive. In fact, the oldest brother is still alive. He is thirty years older than my father--my father is 78 now--and he is still alive.

MAESTREJUAN: Well, this is the side that had the 112-year- old grandfather.

RAYCHAUDHURI: That's right.

MAESTREJUAN: That is amazing. Did you interact with these cousins much or with this extended family?

RAYCHAUDHURI: Yes, on occasions like weddings. Mostly at weddings we used to get together a lot. But I stopped doing that after I started going to college and kind of cut down those things. And I cannot tell you why.

MAESTREJUAN: Well, we can get back into how much you keep in contact with your family in India a little bit later when we talk about more current things. Another question I wanted to ask is, did your sect or--however you want to describe it--your religious group you identified with in India have a particular name?

RAYCHAUDHURI: Yes. They go by the name of-- Well, it's not going to be easy for you to-- It's called Akhanda Mandali.

MAESTREJUAN: Okay. I can get the spelling afterwards, but I just thought it would be interesting, just to give us an idea how organized this is. Somebody may be very interested in knowing that information.

Finally, to move up a little bit more towards the end of the last session, you had mentioned that your American language skills were-- You had difficulty to begin with. How did you bring your language skills up to speed? Did you have any formal language training in

English in India, and did you have to take the Test of English [as a Foreign] Language exam that most foreign students have to take?

RAYCHAUDHURI: You know, we learned English as a second language. So I could write English, I could read English as good as any American, but the accent was a big difficulty for me. It took me a while to learn that. I learned it mostly from my roommates--by talking to them, by trying to understand them--and also maybe radio and TV, those things. But mostly from my roommates. Often they corrected me, the way I used to pronounce them before. They corrected my pronunciation a lot.

MAESTREJUAN: One of the last things you mentioned yesterday that we talked about was--I wanted to put this into some kind of context--that you felt like your thinking was very narrow at the time you were doing your work in [Umadas] Maitra's lab, and that you were focusing really on the mechanisms of protein synthesis rather than maybe looking at the much more general issue of cell development, cell proliferation. But at the time, given that you were working very heavily in an enzymology setting and that this is the mid-eighties, when a lot of the molecular techniques are just beginning to be exploited and there was so much knowledge to learn, how much was this narrow thinking a product of your environment as opposed to not seeing the bigger picture at the time?

RAYCHAUDHURI: Well, you're right. It was not not seeing the bigger picture; that's not true. I had in mind doing research in cancer. My Ph.D. training was--the way I see it now--learning the skills: how to do science, the technicalities, the details of it. Those are the things I learned--in fact, learned very well at that time. And I learned by looking at a very narrow, very focused, very specific thing--just one thing.

The field itself is a narrow field, protein synthesis, because you do not need to read about many other things if you're working on this subject. It doesn't allow you to think of other things, because of the nature of the topic. As a result, I felt that I was working on a narrow area of research. Maybe that was the comment that I was trying to make yesterday. Because of that, I felt that I was deficient compared to others who were involved in a broader area of research. I did get that feeling near the end of my thesis work. The change that I went through at that point, or transition I went through, was probably a result of that understanding that I was not learning a lot, other than trying to do that one thing.

MAESTREJUAN: To go on a little bit to look at the development of your own identity as a scientist, you had mentioned that even before you'd left India you were interested in working on cancer biology or questions of cancer because this was mankind's difficult problem to solve. At the end of your Ph.D. work, you still wanted to work in cancer. How was your idea of doing good science and cancer research transformed from your ideas as a pre-grad student of wanting to do cancer and then, going into your first postdoctoral experience, still wanting to do cancer?

How did it change, or how did it stay the same?

RAYCHAUDHURI: As I said, protein synthesis is less directly related to the cancer problem, so I wanted to do something which was more directly related to cancer. That's why I picked this lab to do my postdoctoral studies, [Joseph R.] Nevins's lab. He was studying viral oncogenes. These are powerful tools to study how a normal cell is converted to a tumor cell. If you just take one of these oncogenes and introduce it into normal cells, they acquire the phenotype of a cancer cell. That was a very simple system. I thought that would be something I would be interested in, and I would be able to learn a lot by studying that. In fact, that's what I did. During my postdoctoral studies I studied a viral oncogene, and I discovered a lot in terms of how this oncogene was converting a normal cell to a cancer cell.

MAESTREJUAN: By identifying that you wanted to move away from anything associated with being an enzymologist to moving into the field of virology, had you identified any other areas that you possibly could do cancer research in? Had you looked at any other labs besides Nevins's lab?

RAYCHAUDHURI: Yes. As I said, I was offered by many labs a postdoctoral position. The person who was very interested was actually at Rockefeller [University], Robert [G.] Roeder--Bob Roeder's lab. He actually offered me a lot, more than he offers to an average postdoc. I realized that that would be a continuation of enzymology. He was trying to recruit me because of my expertise in enzymology. He was, at that point, purifying transcription factors important in mRNA [messenger RNA synthesis. That's an important area and I looked into it very seriously. I considered his lab very seriously, but it appeared to me Nevins's lab would be more appropriate and more directly linked to my interest at that point. It was a difficult choice because Bob Roeder was a very senior person at that point. He was a National Academy [of Sciences of the United States of America] member at that point, whereas Nevins was simply an associate professor at that time. There was a big difference in status, but Nevins was young and was very impressive at that point. He was doing very good science, and I decided to go to his lab. There were other labs I was offered, but I was not sure about those labs. Also, I wanted to stay in New York because of my wife [Srilata Bagchi]. She was in New York, so I didn't want to get out of New York. That would have been difficult.

MAESTREJUAN: Why don't we pursue this a little bit. You didn't come to the United States married?

RAYCHAUDHURI: No.

MAESTREJUAN: So within four years you have a wife. Maybe we can put a little bit of a

personal context back in the story. We've talked off tape that she's a scientist as well. How did you meet?

RAYCHAUDHURI: In [Albert] Einstein [College of Medicine of Yeshiva University], when I was a graduate student.

MAESTREJUAN: Was she a graduate student or postdoc?

RAYCHAUDHURI: She was a postdoc.

MAESTREJUAN: In the same lab?

RAYCHAUDHURI: No, in a different lab.

MAESTREJUAN: So you were pretty much committed to staying in New York City. Were you married at this time?

RAYCHAUDHURI: We got married right after my thesis defense. We knew that she was going to stay there because she was very comfortable in that position she had over there at that point. She didn't want to move, although we ended up moving after a year. Nevins made a very nice offer to her.

MAESTREJUAN: To start a new postdoc in his lab at Duke?

RAYCHAUDHURI: Right.

MAESTREJUAN: So it just basically meant moving from the Bronx down to the East Side. Well, we can get back and talk about that because you do end up collaborating with your wife on several important papers. To pick up with the Nevins lab, how did you bring yourself up to speed into this new field, for you, of virology in clearly a lab that is moving and shaking, so to speak, at Rockefeller?

RAYCHAUDHURI: It was, again, hard work and the zeal to get there. That's all I can say about that. Within a year I published a good paper which had nothing to do with enzymology, so

that tells how speedily I moved at that point in learning things and doing things. That's all I can say.

MAESTREJUAN: To talk a little bit about your work that culminates in a series of interesting and important papers in *PNAS* [*Proceedings of the National Academy of Sciences USA*] and *Cell*, when you started in the Nevins lab, how did you choose to work on the E1A gene and the E2F transcription factor? Was his lab already geared to study adenoviruses and mechanisms?

RAYCHAUDHURI: Yes. That's somewhat interesting. In fact, his interest was-- He was running two main projects. One was studying this viral oncogene. The other project was 3' end processing of messenger RNA which involved isolating factors, and his interest was that I would work on that project. I was very clear about what I was going to work on, so I mentioned to him clearly that I spent five years doing that type of work, and I did not want to do this. It was not very pleasant to him that afternoon when he realized that I would be doing these things. But he was nice. He accepted within a week that I would be doing other things, and he started talking with me about projects.

MAESTREJUAN: Why did you choose to work on the E1A?

RAYCHAUDHURI: As I said, E1A is an oncogene, and this oncogene can convert normal cells to tumor cells. That was my interest. It was very obvious for me to study that.

MAESTREJUAN: If you look at your papers basically in sequential order like I did, it looks like you pursue one logical conclusion to the next to the next to the next. But how clear was it at the time when you were working early on to understand the E1A mechanisms of the transcriptional process that there were other cellular factors involved? Was it basically you knew from the gels that there was something else there? How much was it a hunting expedition, say, to identify the E4F factor versus you were looking basically at the mechanisms of viral oncogenes and how they transform normal cells and happened to stumble across that there are these several other factors involved?

RAYCHAUDHURI: In fact, it was actually both of them. Partly it was hunting for a factor that's regulated by E1A. The logic was to find something in the cell that is a target of E1A and then do genetics on E1A--we knew what region of the E1A protein is involved in transformation--to see whether those regions of the E1A molecule are also important to target the cellular protein. So you're right, it was both--trying to identify cellular targets, and then knowing what we know about E1A's transforming function, trying to link those to these targets to see whether that's an important target or not. For example, if there are regions in the E1A molecule which are not important for transformation, if that region is involved in this target,

then we know this target is not important for transformation, at least from that analysis. Then we can decide and go on to find other more interesting targets that might be directly linked to the transforming ability of E1A.

The E4F work was-- At that time there was this E2F factor identified in the lab, so obviously there was the feeling that there were other factors like E2F that might be regulated by E1A. Can we find them? This hunting for a factor that might be changing its level or activity as a function of E1A was within my expertise at that point. I did this type of work in doing protein synthesis. So I thought I should be able to identify something, and I did. There was another postdoc who joined the lab at the same time, Robert [A.] Rooney. He and I started on this together, sort of. We took a new approach at that point to identify factors. Because the approach was new, Joe thought that maybe both of us could start together and divide it later on.

MAESTREJUAN: Find enough factors that would keep you all fairly busy.

RAYCHAUDHURI: Right. We found one factor, E4F, and then I decided after a year and a half of work that he probably could continue working on that, because E2F-- The stories on E2F were becoming very interesting. I kind of shifted to E2F slowly.

MAESTREJUAN: At the time you were starting this E4F project, how much knowledge [was there] that the E2F project was looking like it was a much more complicated story than originally thought?

RAYCHAUDHURI: See, what I used to do-- I do not know where I grew this, or I cannot tell you how I grew this. I used to talk to everybody in the lab, find out what they're doing, try to help them. This I did a lot. At one point, like 75 percent of Nevins's lab-- I used to run that lab for those postdocs. So what it was was my interest on the projects, and I could see that these E2F factors had a lot more potential. So I myself slowly got involved. It was the interactions. The people I interacted with in Nevins's lab, they found it very helpful because they got a lot of help from me. As a result, I could see what is important. I slowly shifted to E2F that I thought more important at the moment.

MAESTREJUAN: How big was Nevins's lab at this point?

RAYCHAUDHURI: At that point, the lab totaled about twenty people. There were probably fourteen or fifteen postdocs and several technicians and a couple of graduate students.

MAESTREJUAN: To put this into a broader context, when did you make the jump from

looking at this as viral oncogenes to maybe a completely different mechanism of tumor suppressor genes?

RAYCHAUDHURI: It was not a jump, actually. It was simply the logical flow.

MAESTREJUAN: Simply logical. I'm going to ask you to explain that.

RAYCHAUDHURI: About that time Robert [A.] Weinberg and Ed [Edward E.] Harlow published a paper showing that E1A binds to Rb [retinoblastoma] tumor suppressor protein. What we were studying were actually transcription factors which are regulated by E1A, so it was looking at functions of E1A that are related to E1A's transforming ability. But they were looking at what protein binds directly to E1A. We were looking at what transcription factors are regulated by E1A. It turns out that the protein that binds to E1A, the tumor suppressor, in fact regulates E2F. So we showed that that's how E1A activates this transcription factor, by taking away the tumor suppressor. The story was that this tumor suppressor binds to E2F and shuts down the replication genes. What the oncogene is doing is taking this protein away, so this factor is now active to stimulate replication genes. Linking these two involved little enough thinking and knowing the area of research, and I would say I was the one in the lab who could link it.

MAESTREJUAN: And why was that? Why were you the one? I mean, these aren't easy questions, but I'd like to pose them anyway.

RAYCHAUDHURI: You know, I do not want to say that the other-- Probably I had a more prepared mind for it, that I was trying to understand, and I was reading and thinking that that might be this. There were other postdocs who were involved in these studies, and I cannot tell you why it didn't occur to them. But it occurred to me, and the only way I can say is that probably I had the mind-set which was ready to see that those two are probably linked.

That was a huge discovery. A paper that I published--actually Srilata, my wife, was the first author--showed how E1A dissociates cellular complex. It was huge because that opened up the area of studying tumor suppressors, and then so many big labs jumped into this and started working on these factors. In fact, everything followed from that one paper we published on how E1A dissociates cellular complex of this transcription factor. Identifying those proteins or studying the mechanism of dissociation, we started seeing that these are all tumor suppressors.

MAESTREJUAN: What were you thinking at the time that you were getting these results, both in terms of intellectually and scientifically in your idea of always wanting to do good science, but on the other hand also this issue of fame? Being a scientist means a little bit of being famous

or having kind of a personal stake in what happens. When you were getting these results, you had the idea and the results were proving your idea. What were you thinking--? In terms of "God, you know, I really want to do good science and do work in cancer biology. At the same time, I really want to be a good scientist, and part of that is personal fame." I don't want to say fame is the-- But people do need to go get jobs after their postdocs.

RAYCHAUDHURI: Right. So personal fame does not come into the picture at that point, when you are a student or postdoc, everybody knows the things that-- I used to be very aggressive. We'd go to meetings and present my work, so in the area everybody knows me very well. So that's something I did to earn fame, if that's what you're asking: go to meetings and present my work and show off. That's all I did.

But when I was doing this work--trying to make this discovery--it was painful work. It was trying to show-- And then once you develop an idea, a new idea is often difficult for other people to accept. Even Nevins didn't accept the idea for several months, how E1A might be involved in disassociating a complex between Rb and E2F. He had a different mind-set then, so it took him a while to accept that. But once he saw it, he saw everything.

MAESTREJUAN: Why do you think it took him a while to figure this stuff out?

RAYCHAUDHURI: It has to do with the details of E1A. He had this strong feeling that a region of E1A is involved in regulating E2F. And it was known that that region is not involved in binding to tumor suppressors. So it has a lot to do with how he felt about the mechanism, the kind of story he was trying to develop, and what was known in the literature. He could not tie them. I had the result, I had the film of the experiment done, to link them. But it was not enough at that point to convince that that was it. But it had the look of-- I don't know how to explain it. It's like you can see a door and open it. He didn't see it for a while and that was somewhat frustrating for me. It took me several months to convince, but then he came back to me once, telling me that this is what might be going on. [laughs] That was kind of interesting.

MAESTREJUAN: How did you convince him that this was really the case, and then how did you react when he comes back to you and presents it?

RAYCHAUDHURI: Well, this has happened between us many times before that. So when this happened it was like one of those. Both of us kind of took it very easily and friendly. He is a very nice person. If he's wrong, he can see it. He's extremely bright too, because once he sees something, he can see far quite a bit. That's something I learned from him.

MAESTREJUAN: How would you assess your own abilities to be like that with your own

students?

RAYCHAUDHURI: I think I have that ability. I do not have his facility, and he knows that. [laughs] There was a time he thought I was competing with him after I moved here. He was trying to decide what I would be doing and what he would be doing because he was thinking that maybe I will finish before he does. However, the fact is my facilities are like 5 percent of what he has. [laughs] That's another story.

MAESTREJUAN: Well, we should go into that now, or we can wait on that.

RAYCHAUDHURI: All right.

MAESTREJUAN: [pause] Okay.

RAYCHAUDHURI: Do you want me to--?

MAESTREJUAN: You can, or we can come back to it.

RAYCHAUDHURI: Well, it is this university. It has to do with Duke University--what kind of people we bring in the lab. So the kind of people he depends on in his lab and the kind of people I depend on in my lab are different intellectually and in many ways they are different. As a result I realize that-- At about the same point, what happened is two labs in Harvard [Medical School], two big professors in Harvard, saw the thing that we were studying and they jumped into it too--Ed Harlow's lab and David [M.] Livingston's lab. As well as Robert Weinberg's lab. So those are three huge labs, and they started doing the same kinds of things.

It was impossible for me to try and think that I might be able to compete with them from a situation where I do not have the resources, I do not have that kind of people in the lab. So that realization was a frustrating realization, because I was in good places--I was in Einstein, I was in Rockefeller [University]--and I never felt that I am not competitive. I could compete with any lab--anybody--and then get things done faster in my previous lab. When I was in Nevins's lab I could get things done faster than anybody in Harvard or MIT [Massachusetts Institute of Technology] doing the same kinds of things. I presented work before other people did. But after coming here-- I realized it a little late, though; I didn't realize it right away. It took me three, four years to realize that that's not the case anymore.

MAESTREJUAN: We'll explore this a little more later. But when you moved into Nevins's

lab, you were moving into a field of viral oncogenes, which was hot, and a lot of people were jumping into the field. For basic science reasons, but also for the potentials that it might offer in understanding mechanisms of cancer. So you're going from an enzymology lab that you kind of felt was very small and focused on a particular problem to jumping into a field that is very hot and highly competitive. How did you make that transition from going from what you considered kind of a complacent and narrow field into one that is, you could argue, swimming with sharks?

RAYCHAUDHURI: Right. How did I do it? Again, the answer has to be short because it is easy for someone with that kind of training not being able to do this. Again, hard work and just trying to reach a goal and then the zeal to reach a goal. That's all I can tell you. I do not consider myself a superintelligent person because I have seen people who are as intelligent as I am doing poorly or better. But it is I think the zeal to do things, to reach a goal. And then staying with it and avoiding all things that interfere with this, even in personal life. So everything was secondary in my life.

[END OF TAPE 3, SIDE 1]

MAESTREJUAN: Well, then how did you handle it when you kind of opened up this new field, in terms of looking at E1A differently, as a part of a process of tumor suppression rather than viral transformation? You're on the edge of this cutting new field, and suddenly these huge labs are jumping in, and it's clear that if you go ahead with all of this it's going to be survival of the fittest.

RAYCHAUDHURI: That's right, that's right. [pause] What is your question?

MAESTREJUAN: How did you react in terms of the kinds of decisions you were making at the bench, as well as kind of the personal decisions of how much longer to continue with the postdoc and where and how to look for jobs--

RAYCHAUDHURI: Oh, okay.

MAESTREJUAN: --knowing that even though you're opening up basically a new field, the competition is just as big as it was with oncogenes?

RAYCHAUDHURI: Right. Well, the competition did not bother me at all because I had been competitive before for several years. So that became kind of an entertaining thing--to compete and do things before anybody does it. When I started looking for jobs, it did not go that far when

I started looking for jobs. The tumor suppressor story came out from here, actually, after I moved here, after it--

MAESTREJUAN: Your second *Cell* paper.

RAYCHAUDHURI: Right. Before that it was simply an idea, and it was between Nevins, me, and a few other people who were involved. They were the only ones who were thinking that this is it. But at that time Nevins was asking me to stay another year or so to continue. It was my fourth year also, and typically you do not want to extend beyond fourth year. So I was looking for a job. Well, finding a job and then deciding which one to take is another story. But then the tumor suppressor story developed after I moved and started my lab here.

I showed that this is indeed the tumor suppressor, Rb, that is involved in this regulation and the oncogene E1A encoded proteins bind to Rb, leading to release of the E2F transcription factor, which was otherwise sequestered by the Rb tumor suppressor. That is linked to E1A's transformation function, so the thought is E1A transforms cells by binding to this tumor suppressor and taking it away from the system. So it is as if the tumor suppressor is not there, like in cancer which is developed as a result of mutation. The Rb protein is not there, so these patients are predisposed to tumor. Viral oncogene is doing the same thing--it's not changing the DNA but taking the gene product and taking it away from the system.

Are we talking about competition still at the--? Yeah. I published a *Cell* paper from my lab here, and I thought if I can publish a *Cell* paper from my lab here, I could compete. It was at that point I recruited many people in the lab. I was very immature in terms of recruiting people, not knowing that one has to look at them-- I was immature in the sense that I thought that everybody's like me. [laughs] And that was not the case, you know. I was unable to recruit people who I would imagine would work like me. You then change the environment. You convert the lab to a very noncompetitive lab. Because you can imagine at those labs in Harvard they have twenty postdocs, and each one of them is like me. It took me a while to realize that--three, four years. As a result, I was not able to keep pace with these people. I had to slowly shift. I didn't shift too much.

When I realized that I cannot keep pace with them, what I decided to do is try and think, "What is something that would be important after five years? Can I start doing it now?" [laughs] I found something I started doing once I realized that. Those are difficult things to think of, and those are difficult things to do. Now I can see that some of those projects are looking very good--things that we are working on in the lab right now are very exciting. So the trick was to do something that they are not going to do right now--they will do after five years. Can I figure it out? Can I do it now? Then I'm not in the competition but doing something equally important. I would imagine that that's something-- If I didn't do that, I would have been totally lost by now in competition or doing totally different things.

MAESTREJUAN: So what have you decided on? How did you shift your lab specifically? How does a scientist go about trying to figure out where the novel areas are going to be?

RAYCHAUDHURI: It is the difficult part of being a scientist, I think. It is the part which decides how far you will progress or how far you are going to go: Look at things globally. Look at what is important now. What might be important later? How to start things now which people will be interested in in the future. Those involve a lot of thinking. So it involved a lot of global thinking and trying to see the important part of it. That helped me--getting away from the competition, feeling bad about not being able to keep up with these people. That helped me actually a lot. I do things which are important, which were done before everybody, and I feel good about it now.

MAESTREJUAN: We have your most recent papers, so we know what areas you have gone into, but what we don't know is why did you choose to go into these areas. What is it about--?

RAYCHAUDHURI: In fact, the recent papers you saw are actually eight years of research that-- I think I have finished doing those. There is something which is developed more, and then something I have not given you. The paper just got accepted, and I'll probably tell you if we talk about it.

The two things in my mind right now is-- Well, it has to do with cancer. These cancer patients are being treated. We need drugs. We need to know what are the important targets for these drugs. So one of the hypotheses that I was testing is whether this E2F-Rb complex--which is believed to be repressive--is an ultimate target of all signaling pathways in cells that shuts down cell growth? If that is true, if these repressor complexes can shut down growth--if we can establish that--then we might be able to design a drug that will generate more of this and will shut down cell growth. That was something that I was testing.

What I was able to do is link the tumor suppressor called p53 to the Rb pathway of growth suppression. So basically my work showed that p53's function is linked to function of Rb. People thought about it, but no one demonstrated it. In fact, one of my papers in *MCB* [*Molecular and Cellular Biology*] shows that that is indeed the case. We recently showed that another growth inhibitor-- These inhibitors are called Cdk inhibitors. Steve [Stephen J.] Elledge studies them a lot, and some of them he identified. I have a lot of respect for this guy. So with one of the Cdk inhibitors called p27, there are experiments done in mice where the gene has been disrupted. And when the gene is disrupted, these mice have all kinds of tumors. In that way it is a tumor suppressor, and I was trying to show that the function of this tumor suppressor is again linked to this E2F-Rb complex or not.

And we showed in one of these recent papers that just came out in *Molecular Biology of the Cell* how this Cdk inhibitor carries out its function of keeping cells in a nondividing mode. See, one of the basic differences between normal cells and tumor cells is that the normal cells

are resting. In tumor cells they don't rest, they divide. And that's the basic thing I look at. In fact, many cancer drugs that are used are directed to this difference. They inhibit DNA replication so these cells cannot divide. The regulators we study--p27Kip1, p21CiP1--these are regulators which are believed to keep cells in a nondividing mode. What I showed in the last two or three years is that what these inhibitors do is generate the repressor complexes of E2F. What these repressor complexes do is shut down the replication enzyme genes. The result is that there's no replication enzymes in these cells, so these cells cannot replicate.

In our body tissue cells, most of the cells are just sitting there--they're not dividing or replicating because there's no replication enzyme because of this repressor complex. It's when you have mutation in the Rb gene or mutations in this pathway--then you do not have enough repressor complex. You express more of the replication enzyme genes. Cells do not have a choice but to replicate and maybe divide.

What we were also studying is-- This is more related to Pew [Scholars Program in the Biomedical Sciences] funding. It took me a while to finish or get to a point where I can say I have successfully made progress in Pew funding. I proposed to study how this tumor suppressor functions, basically--the Rb tumor suppressor. Well, during the funding period we pursued something which would apparently look like a wrong track. I'm not very clear whether that was a wrong track, but I have to suffer for that in many ways.

However, during the time I also took another approach and recently we have now identified a transcriptional partner of this transcription factor E2F. It is a protein that binds to the same site on E2F where Rb binds. It is a protein that we think is involved during the stimulation of replication enzyme gene expression. It's in the pathway of cell division, so it stimulates replication. It's like opposite to Rb: it binds at the same site as Rb and basically displaces Rb from E2F. It acts more like E1A. E1A displaces Rb from E2F. This one also displaces Rb from E2F, but it then stays there to carry out another function--to stimulate the transcription. That is, I think, very exciting. The exciting part is that this protein turns out to be a DNA repair protein, which was a big surprise for me. DNA repair protein-- See, there are now many, many aspects of it. Let me address this one remark. Am I still on track?

MAESTREJUAN: Oh yeah, this is great.

RAYCHAUDHURI: The one track has to do with the replication and then cell division and tumorigenesis. This protein is acting to displace Rb, to carry out a function that is found in a tumor cell and a dividing cell--expression of the replication enzyme genes. Now, the question is, do we see that these proteins over-express in tumor cells compared to normal cells? What is the regulation of this protein?

The other part of this protein is that it binds to damaged DNA--that was a surprise. We didn't understand at that point why a damaged DNA binding protein is a partner of E2F. Now, that actually explains a lot of interesting phenomena known for a long time. There's a thing

called “transcription-coupled repair.” Many genes are repaired very efficiently during their transcription process. No one knows how these genes are repaired in a transcriptionally coupled manner. There’s a disease called Cockayne’s syndrome. This is a rare genetic disease. These patients cannot repair active genes, and they are missing this transcription-coupled repair function. They have all kinds of abnormalities: they don’t live after their teens; they die in early teens. It turns out that the protein that we identified is structurally very similar to that protein which is involved in Cockayne’s syndrome. So that fits with the notion that this protein might be involved in transcription-coupled repair.

Now, replication genes, remember, are genes that are necessary for DNA replication, which is an essential part of cell division: you replicate DNA and divide--make two cells. If the gene is damaged, you cannot get replication. So there must be some efficient repair mechanisms for these replication enzyme genes, because just normal metabolism of cells generates a lot of DNA damage. And many of this DNA damage could be on the replication enzyme genes. If those damages are there, this cell is not going to replicate, no matter what--if there’s no repair. So it appears that what E2F is doing is recruiting this repair protein, which has two functions: one is to transcribe the replication gene, and ensure that if there is damage, that it sees the damaged site and then repairs it or allows repairing that site. So basically it insures that the replication genes will be repaired.

It has other implications in tumor biology. I’m sure you’re familiar with the fact that--You must have read that breast cancer patients, for example--which is such a huge thing right now in terms of studying--are initially responsive to drugs, and then a significant part of them do not respond to drugs, as if they have acquired drug resistance. Well, it is drug resistance. There are many ways drug resistance is developed in cells. One way is that these tumor cells repair the replication genes very efficiently. The drugs are damaging the DNA. But if you have an efficient repair mechanism, then the drug is not going to work because even if there is damage, it’s going to get repaired.

My thinking is that this damaged DNA binding protein might be involved in drug resistance, because there were some reports that this protein is upregulated in tumor cells which are resistant to drugs. So my thinking, then, is that what E2F is doing is recruiting this protein, and then because there’s an upregulation of this protein in these drug resistant tumors, there is no--

I have to tell you something, because I’m kind of getting ahead of myself.

MAESTREJUAN: Okay.

RAYCHAUDHURI: The scenario that we are testing right now is that this damaged DNA binding might be a way that replication gene expression is regulated. If this protein is an essential partner for the replication gene expression, if damaged DNA binds it, then it’s not there anymore, so E2F cannot function. So damaged DNA basically sequesters it. That fits

nicely with the fact that if you damage DNA, cells do not divide. So that is something we are testing. We think we have good data for it. It's not complete yet, but we're testing. This damaged DNA-binding activity of this protein might be involved in downregulating replication gene expression, and that might be responsible for cell shutoff after DNA damage. But if you have an over-expression of these proteins, damaged DNA cannot sequester all of it, so then something is still available for E2F. That will now assemble a repair complex and repair the damaged site. So I think this might be a mechanism that might be involved in drug resistance in tumor cells.

In the future coming year or two, something I'll be studying is drug resistance. My thinking is that this protein might be playing a very important role. It will fit with everything you see in drug resistance. I did not propose in my Pew proposal to study drug resistance, but we proposed to find something that is a partner of this transcription factor E2F. We found that it has a lot of interesting leads, one being studying drug resistance because that is an important problem right now. If you go to clinics, what you find is the oncologists there are frustrated because these drugs that worked at some point don't work any more. So can we make a bit more progress in understanding drug resistance, and maybe this protein might help us. This line of studies has more direct application to cancer patients, and this is something I like very much, something I wanted to do for a long time. Not just studying what is the basic molecular mechanism of cancer induction, but then use the knowledge to get into a real-life situation where some of these can be useful.

I'll pause and then wait for your next question.

MAESTREJUAN: Okay. Well, what would you say drives the kinds of questions that you ask at the bench? Is it clinical concerns, or is it basic, fundamental principles of the biochemistry of transcription?

RAYCHAUDHURI: So far it has been the fundamental principles of the biochemistry of transcription, but then I also see that my research is not directly helping these patients who are actually suffering from this disease. So I am becoming more interested to spend at least a part of my effort now on-- In fact, what I have done in the last six months or so is started talking to clinicians, started talking to people who are doing this kind of research, and getting into that area where I might be able to help some patients. Well, you know, the problems more directly-- Something I started doing for the last six months or so.

MAESTREJUAN: Well, when you talk to your parents [Phani Busan and Arati Raychaudhuri] and you explain to them what you do, how does your father react now that you perhaps are not a surgeon but are talking to clinicians? Or do you try?

RAYCHAUDHURI: No, my father does not have any problem any more about my not being a

surgeon. [laughter] In fact, he enjoys the fact that I do science. Sometimes when a good thing happens to me, I tell him, "Look, this is what I've gotten." So he can see that I'm enjoying what I'm doing, and he likes the fact that I'm doing--at least at some points--successfully. So I don't think he has any problem. In fact, he enjoys the fact that I'm doing science now.

MAESTREJUAN: Okay. Well, you had mentioned that you suffered by following the wrong track--that you had also had another project that was pushing you in a good track. What happens when you pursue what you think is going to be a novel area--a fruitful area--and it turns out that it's not? What is the price to be paid? I guess another way to put it is, what did you mean by when you "suffered"?

RAYCHAUDHURI: What I have been always doing is running two projects in the lab, knowing that one project might suffer. And it did, meaning it did in a nasty way. "Nasty way" meaning-- In this project I was studying, I was trying to push a story which was not acceptable to many of my peers. I had difficulties publishing those and difficulties getting any funds for those kinds of studies. In fact, I found myself very lonely doing that. But I continued to do it for a while, until I realized that it's a no-go situation, that it's impossible for me to pursue.

MAESTREJUAN: Why?

RAYCHAUDHURI: Well, the NIH [National Institutes of Health]-- You can read the reviewers' comments: they had nothing serious against it, but they're expressing concerns which are not reasonable, as if they cannot accept the observation as something that-- What I think is real they are not thinking might be real. I do not know. Because I did not study any further, I can't tell you. I'd gotten into studying an RNA-binding protein, thinking that might be involved in the regulation by Rb. It's not just me; it turns out two other groups, one in NIH and NCI [National Cancer Institute]--David [E.] Levy--made the same observation that I made. But again, I do not know why I could not convince the reviewers to fund that project. They didn't have anything against the science of it, but it looked like they had a lot against the ideas of it.

That made me suffer because I wanted to study that and I was told that we're just wasting time. I do not know whether that's true, but I could not do anything about it. I did not have other resources to continue to study that and prove my point. I could not do that. And at that point something else started looking good, and I felt it was really important not to just put all the eggs in one basket. All of a sudden something else looking good-- For example, this project I was telling you about started looking good. So it became easy for me to shift all my attention to this and basically stop that.

I gave many of my reagents to David Levy in NCI, who studies that. Maybe he can-- He has money; he doesn't have to write grants. So he can study that.

MAESTREJUAN: Is that the position to have, to get a place where you don't have to write grants?

RAYCHAUDHURI: I thought of that. It would be nice, but then in the long term it is probably bad. Writing grants has a good part of it. That is, it helps you focus; it helps you justify how you're going to spend money. I think writing grants is important. I think it is less comfortable, but it has a lot of positive things to it. Often, during writing an interesting idea develops which normally probably would take me a long time to develop. It's during the writing, trying to focus things and trying to prove one point, and then something comes up. It is during grant writing I find myself reading more than I usually do. So I think there are a lot of positive sides of grant writing.

Do I envy those people who don't--? Yes, I envy those people who don't have to write grants when I am writing a grant, like last week, yes. But you'll see that many of these people who are in NCI [laughs] did good science at some point, but not now. They have a well-funded lab, they don't have to write grants, but I don't think they do--at least many of them-- I do not want to be recorded for this. But I'm not sure that they are as-- Many of them are still doing good science, but I don't see how you continue if you are not pressured in some way.

MAESTREJUAN: So why is it that they aren't doing good science?

RAYCHAUDHURI: Well, some of them are doing good science, but then some of them are not.

MAESTREJUAN: What's the connection between--?

RAYCHAUDHURI: I don't know. Maybe life becomes too comfortable for them.

MAESTREJUAN: Okay. You kind of like this: at Albert Einstein it was really kind of a cutthroat, merciless situation, and then you're in a highly competitive field. You kind of like this competition and this--

RAYCHAUDHURI: No, I think what it does is it helps you--well, that's the way I think--stay on your toes and do important things. Because often we have a tendency to just pursue what we see in the lab. You can always argue any new thing you see is important because these are things you find in a cell, and they are doing important things. Yeah, I mean that logic is there, and you can just go on studying things that are not going to be directly relevant to a disease or to

problems of health.

MAESTREJUAN: Okay. So how do you see these congressional debates over the budget at NIH and the shakedown at NIH, that it needs to be revamped; the peer review issue--some of these are separate issues, but they're also together--that the NIH has to make different decisions now that their budget is being much more closely watched; and that there is this big debate of whether we should fund basic science or we should fund applied or more clinically motivated science?

RAYCHAUDHURI: I think there should be equal efforts to both, because clinical efforts and the science that's directly related to human diseases is something we need to do. Think about how you justify spending money. If we're not trying to solve a human disease, what are we doing? I mean, we develop normally from a fertilized cell. That's not a problem. [laughs] Growing up is not a problem. Why do we study that if we're not solving a disease? So I think that is very important. That I think should be a focus. But if we do not study the basic science--the biology of it--we'll be throwing stones in the dark when it comes to thinking about disease--how to treat patients. So I think both of them are equally important, and I think there should be equal efforts in both.

MAESTREJUAN: Okay. Well, we're moving into this huge area of funding. To pursue some questions a little bit more specifically, I know that at the beginning of your Pew grant, you received a fairly large-sized NIH grant, but I don't have a record of what has happened since. You also got a pretty prestigious postdoctoral fellowship [Damon Runyon-Walter Winchell Foundation Cancer Research Fellow]. How has your funding record been, in terms of getting both federally funded grants and private sources of grants?

RAYCHAUDHURI: Right. I think the NIH grant that I had was on this project and then that led me to this RNA-binding protein, which NIH reviewers did not like. So that's the sad part of the story. However, I was able to get money from American Cancer Society. I always had two grants from American Cancer Society. I did not submit an NIH grant for a while because I realized that they're not going to-- Also I was trying to develop new things with the money I had from ACS. Their two grants that give me like $200,000 a year. That was more than what I was getting from one NIH grant, so money was not a problem. What I decided to do was develop new things and then submit a good grant. So now I feel that I have developed something, and I have submitted two grants to NIH--one last week and the one I submitted in June--which I am hoping will do very well. So yeah, funding-wise, I had funding all the time. I didn't have NIH funding for the last three years or so, but I was funded from the American Cancer Society.

[END OF TAPE 3, SIDE 2]

MAESTREJUAN: What did it mean for the kinds of questions that you asked at the bench at the time as well as your own personal career ambitions that you went two to three years without any NIH [National Institutes of Health] funding?

RAYCHAUDHURI: I'm sorry. I missed the last part of the--

MAESTREJUAN: What did it mean to you, both in terms of the kinds of questions you asked--this is to reiterate a few things that you have already said--as well as your own ideas of how well you can compete within your field as a career scientist, when you went for two to three years without any federal funding?

RAYCHAUDHURI: Although I didn't have federal funding, I had enough funding. As I said, $200,000 from American Cancer Society [ACS] was more than what I had from the NIH. So I was able to do what I wanted to do. Money, fortunately--I cannot predict the future--at least till now has not been a problem. I could do experiments. So federal funding was not an essential part. But then I do believe that I should be able to get funds from NIH with things that I have developed in the last three years. They're looking very good, and I have a strong feeling that I should be able to get it.

MAESTREJUAN: What happens if you don't?

RAYCHAUDHURI: Well, American Cancer Society will still hopefully fund me. [laughs] What would happen if I don't get money from anywhere? That would be a real nightmare. I do not know. I do not know how to answer that question.

MAESTREJUAN: Okay. Well, what difference does it make, in terms of kinds of questions you ask, in terms of the kind of science you do, when the money comes from a private source--like the American Cancer Society--versus a federally funded grant?

RAYCHAUDHURI: The only difference might be that American Cancer Society renewals are quicker, whereas NIH renewals are like after four years, five years. The funding periods are longer. So the NIH money gives you a lot more security--you're seeing four, five years of research--whereas ACS is funding you for three years. So it is the time when you have to renew. Other than that, I do not see a huge difference. [pause]

Yes, I mean, there's always a question, yeah, what if I don't renew my grant? And I do

not know how to answer that. I have to assume that I will be able to get funding from other sources. That becomes the difficult part of doing things with peace of mind.

MAESTREJUAN: Okay. Well, knowing that the American Cancer Society wants to fund grants that are going to lead to a better understanding of cancer, better treatments of cancer, how much does knowing that this is a clinically driven foundation influence how you write the grant, how you think about the project, how you develop the questions, what areas you're going to pursue?

RAYCHAUDHURI: In fact, very little. The reviewers in the study section I go to are not clinicians. They are just like NIH's study section for basic science. It is unique to fill out forms where you say how this is related to cancer, your work, and you have to explain that. Often you have to do it in lay terms, lay language. That's all you need to do. It is clearly easy for me to do because some of the things I do are directly related to cancer. So I never have a problem with that. They are clinically driven, but they do support basic research. In fact, I think there are more study sections for basic research than clinical research.

MAESTREJUAN: What does it mean for science: a case like yours where you have a proven track record and you think this is an interesting area, but you aren't getting any funding for it and you have to make these decisions and go with a project that does look promising and drop another project that potentially had rewards? What does it mean for science when good science is just not going to get funded?

RAYCHAUDHURI: Well, that is always a loss, and then it happens particularly in my kind of situation where I had to think about how much resources I had. For example, there are labs who are funded like $1 million a year. They don't have to worry about these kinds of things. You can take a totally obscure observation and develop totally new things in that kind of lab. So these kinds of things are more practical in labs which have unlimited resources, like Howard Hughes [Medical Institute] labs. So yes, I mean, you can pursue those kind of things.

In my kind of setup--this is something I realize now--I have to do something I can convince the reviewers for funding. Otherwise, it is not going to be worthwhile to study unless I am able to shift myself to the point of-- Or become a Howard Hughes investigator at some point. Then I will have the luxury to pursue those kinds of things. Spending some money and some people's effort in the lab trying to study that RNA-binding protein and stopping it after three years, what that meant was that that became a loss. That money I invested, the people's effort which was invested, the ideas that went into it, and then everything, because it was not taken to the finish line. It is a loss. That is something I realized, and I am not going to do-- I was immature at that point, I must say. I needed a little bit of growing up to understand what is real life in terms of real terms. You cannot pursue this kind of studies, because they may not be funded.

MAESTREJUAN: So how do you balance this zeal that you have said has driven you and has accounted for some of your success and the ideal of science that, no matter what you're looking at, if it's happening in the cell it's important versus this reality that you have to mature, somehow, in this world of science and realize that it's not just about pursuing knowledge, it's not just about doing good science, it's about hedging your bets and taking your calculated risks and playing the grantsmanship game?

RAYCHAUDHURI: That's right, that's right.

MAESTREJUAN: So how do you balance these ideals versus realities?

RAYCHAUDHURI: Well, it is not a difficult thing to do. One thing which is obvious is that--this still I think is right--there are so many important things to do. So some things you think important, twenty other reviewers do not think that's important--it's probably wise for you not to study that. But then there are other important things which not only you think important, but fifteen other reviewers also think important. Given that these are all important things, it is wise to just study something you can sell to the other reviewers.

That's the kind of mentality I have now grown, at least at this point that I have to count on my resources and count on how productive I am compared to how much funds I have. With the kinds of funds I have, I have to decide whether I should do an experiment or not, because many experiments are risky. I think, is that risk worth this much money? So I have now cut down on risky experiments which are, in fact, potentially better than some of the experiments I do. But with limited funds the scope of discovery is also cut a little bit, and I don't think you can do anything about it.

MAESTREJUAN: Could you do better science if you were somewhere else or if perhaps you were appointed as a Howard Hughes Medical Investigator?

RAYCHAUDHURI: I strongly feel that way, yes, yes, and yes. It takes me-- I was talking with a friend of mine who's a Howard Hughes member, and I was telling him the kind of effort that he spends to publish a *Cell* paper, I have to spend the same kind of effort to publish a paper in *MCB* [*Molecular and Cellular Biology*].

MAESTREJUAN: Which means? When you publish in *Cell* versus *MCB*?

RAYCHAUDHURI: It just means that you do not attract that many audience. *Cell* has more audience than *MCB*. But both of them publish good-quality science; it's just the number of audience where you are advertising your science. This is one way of looking at it: you're advertising your science. So yes, I think if I go to a situation like many of my friends are, I would do much better science. I have done that, and I can do that.

From here it is difficult. This university, this medical school [University of Illinois College of Medicine], used to be a teaching institution. The main purpose was to teach medical students. Research was-- Well, okay, if you have interest, if you can get money, do it. It is changing slowly. It is still not a very attractive research institute, so we do not attract good researchers. As a result, this is a difficult place. It's not just ideas. This is experimental science. You can have all the good ideas, but if your colleague doesn't have good hands or doesn't generate good reagents, ideas go down the drain, and I cannot do anything about it. So this is a difficult place in terms of competing.

That's why I realized that just to be able to keep myself above the water, what I have to do is do something else which the big labs are not doing, something which is still very important. I am doing it, and I am hoping that at some point I will be able to get out of this type of situation where I'm considered as a teacher. I teach a lot.

MAESTREJUAN: How much do you teach?

RAYCHAUDHURI: I teach like thirty hours of lecturing. Teaching various departments in many courses, which is good and bad. Good meaning I read a lot--I keep myself updated in many areas of science--but then it takes me away from my research a lot.

MAESTREJUAN: Do you teach undergraduates at all?

RAYCHAUDHURI: No, no.

MAESTREJUAN: Primarily--

RAYCHAUDHURI: Primarily Ph.D. and M.D. students.

MAESTREJUAN: Okay. To go back a little bit, why did you come here to the University of Illinois after your postdoc and why do you stay?

RAYCHAUDHURI: It had to do with my wife [Srilata Bagchi]'s job--two jobs. Well, we ended up in the same lab doing a postdoc doing the same things. What happens when a husband and wife are working in the same lab, you go home, talk about projects and talk about science, and then the next day when you go to the lab, try to do that.

It started from [Joseph R.] Nevins's lab basically. A point came that I was generating reagents and she was running experiments or she was preparing reagents and I was running the experiment. We were doing the same thing. When these two people are looking for a job, it's an impossible situation. Most universities--the search committees--don't want to-- Now I myself serve in two search committees, and I can see the problem. [laughs] Although I sympathize with these applicants, I can see the problems the research committees face when there's husband and wife applicants. Those are all job applicants, and it's easy to a find husband and wife in there looking for a job. In the same university, it is like impossible. Same town is a possibility. So whenever I went for a job interview, I mentioned, and it looked like-- [laughs] The search committee expressed that it's such a-- In many places I remembered they became just unhappy that they were going to lose me--they cannot recruit me. So that was a problem.

In this place what happened was-- Although it was quite early during our job-hunting period, what happened is I had a friend from Rockefeller [University] who was in this department. He really wanted to get me here, and so he talked to the chairman. The chairman found a job for my wife in the College of Dentistry. So that's how we ended up here. In fact, David [E.] Levy was trying to get me to NYU [New York University] at that point. It would have been much nicer for me to get there than-- Well, they didn't have space for me. I had to wait six or eight months for a lab space, so that was a problem. But this place, I had a friend here who's a good scientist who's, again, common friends with David Levy and me. Although when I was looking for a job I did not hear about this place--this university was not known for research at that time--it was an acceptable-- And they made a very nice offer. They gave me everything I wanted. And my wife wanted. So it worked out nicely at that point.

Well, that explains why I'm here.

MAESTREJUAN: Yeah, okay. So why do you stay?

RAYCHAUDHURI: Why did I stay? I wanted to get tenure before I moved.

MAESTREJUAN: Okay. Have you gotten tenure?

RAYCHAUDHURI: Yes.

MAESTREJUAN: Last year?

RAYCHAUDHURI: Yes. So now why am I still here? I'm waiting for my wife to get tenure. [laughs]

MAESTREJUAN: Okay. She hasn't gotten tenure yet?

RAYCHAUDHURI: No, she's going through this year. So that is something: a year from now I will decide how long I want to stay here. This university has plus things, too to consider. When you're not thinking science, when thinking job, this is not bad because my nine-month salary is guaranteed even if I don't do anything. So that is a plus thing, that your nine-month salary is guaranteed in this university. There are other universities where even though there is tenure, they don't guarantee a significant part of your salary, although you have tenure. So I do not know what "tenure" means. So there are some good things too, here. I have to balance this and see if I go to another place, scientifically how much I will gain, because I am going to loose some of this guarantee.

MAESTREJUAN: You're guaranteed 100 percent of your salary. You don't have to get any of your salary out of your grants.

RAYCHAUDHURI: Right.

MAESTREJUAN: That's great. That's highly unusual for Pew scholars. How much in indirect costs does the university take out of your grant to cover overhead and things?

RAYCHAUDHURI: This comes from the granting agency, so it doesn't bother me. The indirect cost is the other part of the grant which I never see anyway.

MAESTREJUAN: Yeah, okay. How does it look for your wife to get tenure? How's her work going?

RAYCHAUDHURI: Well, this year I think she's looking very good. We just have to wait and see. There are so many things involved in tenure. I tell you, it is like a torture. Mine went through like butter. I got very good letters from people, which is an important part. They ask these reviewers: Are you going to tenure this person in your university? Which is a difficult question when someone in Harvard [University] is saying this, or even UCLA saying this, because this is an applicant from UIC [University of Illinois at Chicago], which is not a famous

place for research and things like that. Fortunately because I kept myself up publishing in good journals, it went through. I got very good letters. As I said, for my wife, we have to wait and see.

MAESTREJUAN: What does it mean once you both have tenure?

RAYCHAUDHURI: Then we have to really sit down and think. Obviously I want to move on to a situation where I can at least attract good people to my lab. For example, what I might want to do is go to another university in Chicago where I'll be able to attract better people. That is a consideration. Another consideration would be, for example, if I get a very good offer from somewhere else. Whether I can convince her to move with a less attractive job for her, that would be something that we have to talk [about].

We still collaborate doing science in some projects, and both of us understand that this is a difficult place to do good science. So given doing good science is a primary goal, if we get opportunities somewhere where we think we will be able to do good science, we might sacrifice something and just move. That's something I'm talking as a future thing.

MAESTREJUAN: I'm probably going to be jumping around a little bit as we fit everything into this session. But I'll go ahead and ask you a couple of questions. It's not so unusual that a Pew scholar is married to another scientist. It doesn't come up so often, though, that they collaborate so closely. You had already mentioned that you go home and talk science at the dinner table--it naturally happened that way being postdocs together in Nevins's lab. But issues of authorship and proprietary rights of who did what in an experiment cause problems with complete strangers, let alone with people who share their professional and personal lives. How do you two arrive at these decisions of who's going to be first author, who's going to be last author?

RAYCHAUDHURI: Well, we had a very good setup in Nevins's lab. That is, in one paper she's first author and in the other paper I'm first author, no matter what. So often she was a loser, and in the other case I was a loser. But that's how it was: in this paper she is the first author, next paper I'm the first author. Because we were doing things equally and there's no way you can divide these things. That is a problem, and that's how we accepted it. In one meeting I presented the stuff; she presented in the next meeting. Often she probably felt bad. I probably felt bad. But then, that's the only way we could do it.

After moving here it became a lot easier in the sense that we started doing thing--Although the first paper was again together. She was the first author; I was the last author. Well, I was the corresponding author, so I didn't loose any credit for that. But then we slowly started working on slightly different things. It was important for her and for me to work on different things, although there are overlaps. We still publish some things together, but the main projects

are different now. That had caused problems in her tenure committee, that many of her papers are with me. So after her initial review, she has now published several papers from her lab by herself.

MAESTREJUAN: Was that an issue in your tenure committee?

RAYCHAUDHURI: No, it was not.

MAESTREJUAN: Why do you think that is the case?

RAYCHAUDHURI: Well, what happened is I published more than she did, and as a result many papers she was just-- The project became different; she was not an author in many papers. So that problem did not arise in my case. In her case the problem was-- The College of Dentistry is worse than this. The question is, how low can you go? Often I warned her. [laughs] The scientific environment, her situation is even worse than mine. There's no graduate students she could get. She had to depend on postdocs and being able to recruit good postdocs. So her situation was a lot more difficult than mine. There was a period where she was not productive at all. She had to struggle, do things by herself, and then try to develop things. Now it looks much better for her. In fact, her tenure committees feel very strongly about her. Things might just go through this year. We just have to wait and see.

MAESTREJUAN: How much do you think gender has played a role in the differences in your experiences in science and tenure cases and her experience in science and tenure cases?

RAYCHAUDHURI: Well, her tenure committee, as well as the chairman, complained-- My daughter [Keya Raychaudhuri] used to suffer a lot from cold, like tonsil, so often my wife would just-- Whenever my daughter was sick, she's the one. We didn't divide equally at that thing. I was told by my chairman that that was an unfair thing that I did to her.

MAESTREJUAN: Your chairman told you this.

RAYCHAUDHURI: Yes.

MAESTREJUAN: What was your response?

RAYCHAUDHURI: My response was, well, if you think that way, it is. Now I tend to share more equally, I guess.

MAESTREJUAN: Well, you were raised in a traditional culture, and being the oldest son you had a certain role expected of you, and you had older sisters who had different expectations. How much are your own current attitudes of the roles of men and women carried forward because of this traditional background? Your grandmothers' names you aren't quite sure of the spelling; your mother [Arati Raychaudhuri] didn't have the influence in the same way that your father [Phani Bhusan Raychaudhuri] did in your life, whether directing it positively or negatively; and your own attitudes towards the roles that women are expected to play, not only your wife, but say graduate students and postdocs who choose to pursue careers in science and pursue family obligations--

RAYCHAUDHURI: Well, this is something I must say that I am still working on in a sense. Gender has not been a problem for me: I treat a student as a student. Often, when there's a female student, I had to be a little careful, tell her, "Look, when you're alone at late nights, close the door." I didn't say it to a male student. And often I've found myself that I'm taking maybe an extra care to female students, which they did not mind. So when it came to students, I had absolutely no problems. Otherwise, I just treated them like students. Gender was simply not an issue; I look at a person as a person. That's how I deal with people.

When it came to family life, yes, I was happier when I saw-- Oftentimes I gave importance to my work that I have to go do, I have to get this done. I have done that, and I think that I could have shared that equally without losing much of what I achieved. But I did it. Right now I try to share more equally, as I said. I know women are-- In fact, one of my students-- So far I've graduated four students: one female and three male. The female student probably published as many papers as the other best student, the male student. So I had two real good students: one was female and one a Russian student. This female American student published as many papers as the other Russian student. And she has gone on to good places. In terms of ability, she was as able as any male student that I had. Frankly speaking, I do not see any difference between abilities.

MAESTREJUAN: What about the situation when you ask that these reagents need to be mixed up, and your female graduate student says, "I'm sorry, my kid's sick. I've got to go home. I'll do it first thing in the morning"?

RAYCHAUDHURI: It hasn't happened to me. My female students were younger. Now that I've seen one of my daughters growing, I know the problem of a human life in a more matured way. Because my postdocs, they take off for their-- And I do not mind. I can see.

Although when I was a postdoc, I do not know that I would have done that. As I said,

everything was kind of secondary to me. Doing things in the lab was primary. It still is. Doing things in the lab is the primary goal, but I have now been able to take out time. Like there was a time when I was a postdoc, or even initial period as an assistant professor here, every second, every minute in my lab sort of counted. Now I can see that that is not that important. I can make up for it and still take care of my daughter. So that has changed a little bit.

MAESTREJUAN: And what expectations do you have for your daughter in terms of what she should do with her life?

RAYCHAUDHURI: Well, frankly speaking, I definitely want her to be an independent person. It doesn't matter what career she takes. But then--now you probably will get me for this!--I did mention to her when she asked me that I would like to see her become a surgeon.

MAESTREJUAN: No way! [laughs] Why is that?

RAYCHAUDHURI: I do not know why is that, but I think that's one way you help people. They are the people who directly help people.

MAESTREJUAN: Did you tell your father you said this?

RAYCHAUDHURI: No. But I do not know whether-- I am not going to push her. I will encourage her. I think that these surgeons cure diseases. They take out something, and that's something that another person cannot do--I cannot do.

[END OF TAPE 4, SIDE 1]

MAESTREJUAN: Well, in terms of like what your father did--he brought you into his pharmacy and showed you how to measure stuff--do you or your wife ever bring your daughter into the lab and let her play around? Well, I wouldn't say "play around," since you do use radioactive isotopes in here, I noticed, but, you know--

RAYCHAUDHURI: Yes, in fact. Well, because we still talk science at home a lot, she knows some of the terms that we use. [laughs] She comes to my lab whenever she has time off from school-- I bring her, or oftentimes these days what happens is she stays in my lab in the-- Well, in the morning to my wife's lab and then the afternoon in my lab. So yes, she comes a lot.

MAESTREJUAN: Given that she's been raised with people talking shop at the dinner table, does she contribute to your scientific ideas as well now?

RAYCHAUDHURI: [laughs] No. That has not happened, but she would ask when she knows-- She knows that I'm submitting a paper; she'll ask, "What happened?" I tell her, "Look, the paper I submitted got accepted." She says, "Oh, let's go celebrate." Things like that. You know, she's nine years old--she's still a child.

MAESTREJUAN: Do you sit down and do mathematical puzzles with her?

RAYCHAUDHURI: I have not done that, but what I have started to do is-- Well, her mother used to do homework with her, take care of that part. But since this year I have started doing it. I am hoping that I would slowly take her-- I do not want to do it like the way my grandfather [Surenda Bhattacharya] did to me because I don't think it will work. You know, back then in India, you play games with your friends. At home there's nothing else to do. There's no TV. The radio is very well controlled. There's only one or two stations that you can play, only a few interesting programs you can listen to. At home there's not too much you can do. So if you're stuck with a mathematical puzzle, well, that's one way to continue doing. But here at home, she has so many attractions. [tape recorder off]

MAESTREJUAN: To move around a bit, when you originally had come to the United States, you had mentioned that you thought you'd get a Ph.D. and then go back to India and work at some research institute. I wanted to ask, what happened to that idea? Why did you choose to do a postdoc in the United States, and why haven't you chosen to return to India, and is that still a possibility?

RAYCHAUDHURI: The opportunity to do good science made the difference. If I go to India, I won't be able to do science at the level I'm doing now. That will be a totally different life, and I will have to take simply a teaching job. I have thought of that seriously many, many times, and I realized that I won't be able to do any good science if I go back to India because there's simply not enough money, not enough opportunity to do science. So as long as I want to do science, this is heaven, basically. I miss my family. Yeah, if I loose all my grants, I will go back. [laughs] If I am unable to do science, I probably will go back to India, because there are other interesting things that I probably would be able to enjoy if I cannot do science.

MAESTREJUAN: Such as?

RAYCHAUDHURI: Oh, the culture is so rich. I probably will enjoy it [more] over there than here, although my growing daughter might have a say at that point. Those are difficult things to talk about.

MAESTREJUAN: Well, if you had to list one or two things that you miss most about India, in terms of its rich culture, what would pop to your mind?

RAYCHAUDHURI: Well, I used to go to plays a lot. Those plays are--if you compare to plays in this country--very comparable in terms of quality. But then, they are dealing with the tradition, culture, of that country where I was born and I grew up for twenty-two, twenty-three years before coming here. For example, last night, this program I went to, I enjoyed it enormously. Those are the kind of things that I would be able to do more if I go.

Plus, my family, everybody is there--my sisters, my brother, and then-- Especially my brother [Pranab Raychaudhuri]. I am so fond of him. He's very funny--he's humorous. He just sits there and makes you laugh. It's so entertaining just to spend time with him. So if I cannot do science, then I'll have a lot more to do in India than I have here. Because if I do not do science, the only thing I'll be doing is teaching, and that's all--I can do that in India too.

MAESTREJUAN: Okay. Well, you had mentioned several minutes ago that your friend, the Howard Hughes [Medical Institute] investigator, you spend equal amounts of energy and he publishes in *Cell* and you publish in *MCB* and that it is important where you publish because they're both good journals, but the audience is different. "You have to advertise your science," is what you said. Why does one have to advertise their science?

RAYCHAUDHURI: Well, this is an unfortunate thing. There is not a good answer for it. The thing is, if you want to get funds, you have to be a known person. Often in review sessions, they look at where you publish, and they look at whether they know you. So it is important in terms of getting funds, it is important in terms of drawing attraction to what you're doing--basically everything that is related to advertisement. Often I have seen that paper I published in *Cell* [S. Bagchi et al., 1991. The retinoblastoma protein copurifies with E2F-I, an E1A-regulated inhibitor of the transcription factor E2F. *Cell* 65:1063-72] draw so much attention that people have gotten into it and done good work. That is a big help in the scientific community.

Unfortunately that has not happened to works that I have published in other journals. These journals like *Cell*, because many people read it, there's a very good chance someone will like it and do something which adds to my work, or take it to a totally different direction from what I have done. So is important to advertize your science.

MAESTREJUAN: Okay. The Howard Hughes Medical Institute found itself with too much

money this year and appointed twenty or twenty-two extra investigators this year in order to meet their tax bracket needs. Being at this institution, do you think that the Howard Hughes Medical Institute would appoint you an investigatorship here? Or even a colleague in your department?

RAYCHAUDHURI: I do not know the deal there. I would like to find out about it--how they go about it. Unfortunately, I do not know the deal. Obviously the university has to make some kind of effort to get Howard Hughes to show interest in one of the faculty members--that's how I think it works. Frankly speaking, I do not have the information.

MAESTREJUAN: Right, okay. But if they did give you the nod, you'd take it?

RAYCHAUDHURI: Oh, yeah. [laughs]

MAESTREJUAN: Okay. I wanted to go back to the issue of the ability you've had here to attract good graduate students and good postdocs. We've been interviewing on Saturday and Sunday, and your lab has certainly been quiet. But even walking down the hallways, there's other labs that are even more quiet than yours right now. What difference does it make in terms of your ability to attract good students versus your ability to attract students, just to have students in here? You had mentioned that right now you don't have that many because you just graduated several.

RAYCHAUDHURI: Right. Well, I have taken students who are average. They have other interests in life. Doing a Ph.D. is a means of earning a salary. I had problems with that kind of person, and I did not consider them as good students. And obviously they are not going to go very far unless they change their ideas altogether. What I try to do is tell them that there's a purpose here, and the purpose is probably more important than any average thing you do on a routine basis at home. But it simply doesn't work to-- I get the feeling that some students just have it. Some people just have it. It is just so easy to tell them and they know what you're talking [about]. And there's some students you simply cannot communicate and tell them that-- If you have an urge to do something in life, how can you stay away from the lab? I do not understand this.

That is the unfortunate scenario in this university. That's what you saw on this floor: there's so many labs you walked by, and there's not a single human being working in those labs. I never saw it in other universities I was in. I come here every day--I come here Saturdays, Sundays--and try to do things. You see the problem that these people who work here don't have the urge to get something done. Unfortunately I have not found that kind of people here, whereas in other places-- The thing is, it has to do with the environment. If there are six people in the lab, if three of them are coming in the weekend trying to do things, that probably

motivates other people. In this kind of place it is very hard to get three people to do—The university was never known to be a good research institute.

They are obviously trying now. The administration is now trying to build it, but it will take some time. It will take some time. Their hope is if they could recruit good faculty members--aggressive researchers--then this place might become-- But we--who were being recruited by the people--we had the trouble of recruiting associates who are good. I cannot imagine a good American student will come to this university. There's no reason for a good American student to come to this university because there's U of C [University of Chicago], there's Northwestern [University]. They are better-known places for their research. Although in terms of doing science, my lab does as good science as someone in U of C or Northwestern. I get invited to give presentations, and I know that my science is as good as them. But unfortunately, the university is not attractive. So that is a deficiency here.

MAESTREJUAN: In the ideal situation, how big would you want your lab to be?

RAYCHAUDHURI: I have been to big labs, and big labs, although they have like twenty, twenty-five people in the lab, at any given time there are only five people who are really good and productive. You know, if I had two good people in the lab, I can do a lot. At some point in my lab there was like about ten people, and then there was a time in my lab with like four people--like right now maybe. I am as productive, if not more--producing more and with a better- quality work. So I do not think I want to grow very big. But I would like to be very selective and get good people to work with me, because I ended up spending a lot of time trying to train them. It is a lot of time I spend trying to train them, and I want to see that go somewhere. That was the feeling I got with one of my students--that I spent quite a bit of time in four years talking to him every day. And then when this person gets a Ph.D. and if his life is totally driven by something else unrelated to science, then where did your effort go?

MAESTREJUAN: What about getting good technicians? How is your ability to get good technicians, and is the university--? It seems to me this would be a fairly competitive market in Chicago, given all the institutions.

RAYCHAUDHURI: Right. Yeah, that's something I have started thinking, that I would probably start recruiting technicians. Often there are postdocs whose wife is looking for a technician's position. They are able persons. Often we end up in a situation like this.

I have not recruited anybody as a full-time technician in my lab. I have always had part-time technicians in my lab. The initial four, five years, I was against having a technician in my lab as full-time worker because in my postdoctoral life I had difficulties dealing with technicians. Often I found that the ones that I dealt with do not think and they just do what they are told to do. On the other hand, I found that the postdocs think, and then they try to do things

by themselves. So I was more interested to recruit postdocs than technicians.

But then that idea is probably going to change a little bit. I've found that often some postdocs are very disruptive in their thinking and in their doing things in the lab. One postdoc I had, I had to ask him to leave after two years. He worked hard, but he had his ideas about doing things which were not right. It's just not logical. On the other hand, a technician would have listened to me more, and I would have been more productive with a technician. So yeah, it's something I'm thinking about, but I have not done it yet.

MAESTREJUAN: Okay. Well, you've worked within a variety of scientific settings. You had mentioned that Albert Einstein [College of Medicine of Yeshiva University] was very much, you thought, like the German system where the chair is the big person and then the assistant professors are underneath him. It's changed now, but Rockefeller was clearly of the empire kind of structure of American science. And you worked in medical colleges at the Rockefeller, which doesn't even have an undergraduate population--it's solely graduate and postdocs. And at Duke, which I don't know at the time, but Nevins now is a Howard Hughes Medical Investigator, so you worked under that umbrella. And you worked here, which you have said has been traditionally known as a teaching institution--emphasis on teaching rather than bench science. And you just mentioned that perhaps technicians versus postdocs is an important issue of-- There are certain advantages to having postdocs, but there are certain advantages of having technicians. How we structure our science across the various institutions-- One, to maximize intellectual resources; and two, to maximize financial resources. Because if a good scientist happens to be stuck at an institution like this, and another scientist happens to be at an institution as a Howard Hughes Medical Investigator, it could change the complete nature of the kind of science that they do. Can you see a way of structuring our science to maximize all these different resources?

RAYCHAUDHURI: Well, you are asking a difficult question. You're right. Structuring science-- The ideal situation--obviously if you ask me--I would like to be in a Howard Hughes Institute: do the best science there and invent, discover new things. That's what I 'd like to do aggressively, in an environment where my associates are intelligent, dedicated scientists.

In a place like this, it becomes more trying to convert nonbelievers. I do not know how productive these things are in terms of training people. So this place has to develop. This kind of university, this kind of place has to develop to become more attractive so that they can afford to be a little selective in terms of who they recruit as students, who they recruit as postdocs, like other big universities. Many students who are recruited here won't be recruited there. But people like me who are stuck here, they shouldn't do science?

Well, there are two ways of thinking. My way of thinking is, well, they should do science, but this university should develop such that they should try to help these kind of people in whatever way they can so that they can do science in a more competitive way rather than cutting down this kind of university from doing science. That's not going to be a fair thing,

because I still think that in this university there are some good scientists--there are other Pew scholars in this university too--who do good science. So if this university at some point earned the fame of U of C--for example, if this university becomes aggressive, builds new buildings, attracts good scientists from outside--senior scientists from outside, come in here and run their labs--then this will become an attractive place.

So it has to do with the university more, how they want to develop science in the university. The university administration has to change a little bit. Like many universities, they have to change. They spent a lot of money, they built buildings, they offered a lot of things to just two or three senior, well-known scientists, and they have moved in. As a result, they're there, they become centers of attraction for other scientists to come into this place. I think that's how this type of university has to develop. It is unfortunate that I 'm here for seven years. I have not seen that the administrators here are going after this kind of thing more aggressively. They tried, but they have not done it successfully.

I do not know whether I answered your question.

MAESTREJUAN: Well, do you see in your future a move into administration, or more administrative-type responsibilities, that would put you more in a position to make some of these changes?

RAYCHAUDHURI: Well, not in the recent future, because now I think I am more on the bench. I like to-- Because once you move into administration, it becomes a different ball game. If I decide that this is the university I'm going to spend my whole life at, yes, at some point I would like to get into this and make sure that I try to bring in good people in this university. I am actively involved in such committees. I serve in multiple search committees, often outside the department, just so that I can help identify good scientists come in here. As I said, if I decide to stay here, I would definitely like to take a part and improve the situation, because many administrators here are here for a long time, and they are comfortable with things here. People who are comfortable with the situation--they're not going to change anything. It is only the people who are not comfortable.

MAESTREJUAN: Okay. Let me ask something completely different, or maybe not completely different, but how do you define good science, and how would you define a good scientist?

RAYCHAUDHURI: Good science is that you pursue one thing and build a story--make an observation and then build a story, build-- Basically, from one observation you go on building stories: pursue one thing, however small it is, pursue it and take it to bigger things that people know but didn't think that way. I think that's good science. Obviously the person who's doing this is a good scientist.

So I think the person who develops a new idea and pursues it. Often I have seen people publish one paper and move on, does not pursue that. Then that becomes a loss. It happened to me also. I like to, you know, develop things from one thing to-- It's like growing a tree basically: it must be logically linked to one thing. Most good scientists are like this. That's how they do science.

MAESTREJUAN: Okay. Well, I think two more questions, and then I'll turn it over to you. You developed a new assay--it was in your *PNAS* paper [S. Bagchi et al., 1989. Phosphorylation-dependent activation for the adenovirus-inducible E2F transcription factor in a cell-free system. Proceedings of the National Academy of Sciences USA 86:4352-56] --to assay for phosphorylation, I believe. But you also, in a *Cell* paper [S. Bagchi et al., 1991. The retinoblastoma protein copurifies with E2F-I, an E1A-regulated inhibitor of the transcription factor E2F. *Cell* 65:1063-72], proposed a novel mechanism to explain transcription. Where do you see your abilities lying? Is it in developing new technologies in order to overcome technical problems or do you see yourself more as a proposer of new theories of thinking about things and proposing new ideas?

RAYCHAUDHURI: Yeah, it is very clear to me that I am not good at developing new techniques. I spend very little time-- In fact, I like to see other people developing techniques and use them to prove my ideas. I mainly try to pursue story but not techniques. I know it is very important, but I don't have a knack for it. I have seen people doing it: they spend a lot of time trying to develop a technique. I know that that is very important because that will have a lot of application and use. I spend very little time on that kind of thing. I would rather spend time trying to prove my ideas using those techniques. So I spend a lot less time.

MAESTREJUAN: Where do the true revolutions come from, then? Is it breaking technology barriers or breaking theoretical barriers?

RAYCHAUDHURI: It's both. It has a technological-- Those are so important. Without that I can't have as many ideas as I can. It's no use.

MAESTREJUAN: Okay. Well, the last question is how has the Pew Scholars Program [in the Biomedical Sciences] influenced both your intellectual development as a scientist and your professional development as a scientist?

RAYCHAUDHURI: Well, it has helped me in many ways. First of all, the money was given to me at a time when I really needed it. I could recruit people and try to do what I was trying to do. In fact, something that I think I have developed now is because of Pew money that I have gotten four, five, six years ago. It took me a bit longer, but I did develop it. And I think that what I

have developed is much more important than what I proposed. So because of the Pew money, I could do that.

The other thing that happened is the [Pew Scholars and Fellows Program Annual] Meetings that I went to. I saw many, many good scientists doing totally different kinds of things at one place. Which I am not used to seeing before that because I used to go to meetings that are related to my work. But here is a meeting where I saw neurobiologists, I saw people who are doing totally different things, but they're doing outstanding science. So that part also played, I think, a big role in trying to change my thinking or develop my thinking, or to my maturity.

So I consider myself blessed with this Pew foundation because I was able to see these people because of Pew scholarship. And of course the funding helped me a lot.

MAESTREJUAN: So do you plan on attending the next alumni meeting?

RAYCHAUDHURI: Oh, yes. [laughs]

MAESTREJUAN: Okay. Well, that's it for the questions I have. At this point I would like to turn it over to you and ask you if there's any topics you'd like to talk about that we haven't covered?

RAYCHAUDHURI: I think we covered almost everything. [laughter] No, I think I have talked too much.

MAESTREJUAN: Okay. Well, thank you very much for taking the time out to do this interview.

RAYCHAUDHURI: Sure, sure.

MAESTREJUAN: Thanks a lot.

[END OF TAPE 4, SIDE 2]

[END OF INTERVIEW]

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