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HAO WU

The Pew Scholars Program in the Biomedical Sciences

Transcript of an Interview
Conducted by

Karen A. Frenkel

at

Weill Medical College of Cornell University
New York, New York

on

30 and 31 January 2008
(With Subsequent Corrections and Additions)

Hao Wu

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HAO WU

1964	Born in Beijing, China on 23 May

Education

1985	B.S. equivalent, Biology, Peking University and Peking Union Medical College
1988	M.D. candidate, Peking Union Medical College
1992	Ph.D., Biochemistry, Purdue University

Professional Experience

Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences, Beijing China

1987	Research Assistant

Columbia University, New York, New York

1992-1997	Aaron Diamond Postdoctoral Fellow, with Wayne A. Hendrickson

Weill Medical College of Cornell University

1997-2001	Assistant Professor, Department of Biochemistry
2001-2003	Associate Professor, Department of Biochemistry
2003-present	Professor, Department of Biochemistry

Honors

1981	International Math Olympiad
1982-1988	Award for Outstanding Academic Achievement, Peking Union Medical College (First in GPA for the entire period)
1989	Member, Gamma Sigma Delta
1989-1992	Howard Hughes Medical Institute, Pre-doctoral Fellowship
1993-1996	Aaron Diamond Foundation, Postdoctoral Fellowship
2000	Junior Committee Award, Weill Medical College of Cornell University
2000-2004	Pew Scholar in the Biomedical Sciences
2002-2004	Rita Allen Scholar Award
2003	Margaret Oakley Dayhoff Award in Biophysics, The Biophysical Society
2003	[New York City] Mayor's Award for Excellence in Science and Technology

ABSTRACT

Hao Wu's oral history begins with a discussion of her childhood in China, during which her family was separated and forced to relocate to the countryside during the Cultural Revolution. Despite the difficulties associated with such turmoil, including the death of her father, Wu excelled in school. She consistently ranked highest in her class, and on the National College Entrance Exam she ranked fifth of all test-takers in the city of Beijing. Wu enrolled in Peking Union Medical College in Beijing, a highly selective, combined eight year bachelor's and medical degree program founded by the Rockefeller Foundation. While there she took courses taught in English and a semester of Immunology research which piqued her interest in laboratory work, leading her away from the clinical world of medicine. At an international biochemistry meeting, Wu discovered the structural biology research of Michael Rossmann, research that would ultimately bring her to the United States. After some difficulty obtaining her visa, Wu began the Ph.D. program at Purdue University joining Rossmann's laboratory. Her research on canine parvovirus crystals brought her to the University of Kentucky and also to Norwich, England briefly. Additionally Wu worked on a Fortran computational modeling program during her graduate studies. While at Purdue, Wu met a colleague she later married, though she quickly discovered that he did not share her views about science or appreciate the difficulty of balancing family life and research. Wu chose her postdoctoral position at Columbia University with Wayne A. Hendrickson because her partner's job was in Connecticut.

Wu's research on CD4 and HCG led to multiple publications including a 1997 *Nature* paper. Although Wu considered becoming a Research Assistant instead of a PI, after she solved the structure of CD4 she decided to test the job market and ultimately joined the faculty at Weill Medical College of Cornell University. Staying in New York City did not disrupt her children's education and allowed Wu to take advantage of the large structural biology community within the city. Shortly after beginning at Cornell, Wu received the Pew Scholars in the Biomedical Sciences Award. This fellowship helped her solve structures and perform the initial work necessary in order to receive a National Institutes of Health grant. During the oral history, Wu discussed her research group's work on TRAF and AIF and the difficulties associated with the funding of crystallographic research. She also touched on the current struggle between basic and translational science; competition from other laboratories; the complexities of balancing family and work; and the difficulties women in science face. At many points throughout the interview Wu returned the discussion to China and its ascendancy with respect to science, her own educational experiences there, and the teaching she now does in China.

INTERVIEWER

Karen A. Frenkel is a writer, documentary producer, and author specializing in science and technology and their impacts on society. She wrote *Robots: Machines in Man's Image* (Harmony 1985) with Isaac Asimov. Her articles have appeared in many magazines and newspapers including *The New York Times*, *CyberTimes*, *Business Week, Communications Magazine, Discover*, *Forbes*, *New Media, Personal Computing, Scientific American, Scientific American MIND, The Village Voice*, and *Technology Review*. Ms. Frenkel's award-winning documentary films, *Net Learning* and *Minerva's Machine: Women and Computing* aired on

Public Television. She has been an interviewer for Columbia University's Oral History Research Center's 9/11 Narrative and Memory project, The National Press Foundation's Oral History of Women in Journalism, and the International Psychoanalytic Institute for Training and Research's Oral History. Professional memberships include: The Authors Guild, National Association of Science Writers, Writer's Guild of America East, and New York Women in Film and Television: Past Member of the Board and Director of Programming. Her website is www.karenafrenkel.com.

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INTERVIEWEE: **Hao Wu**

INTERVIEWER: **Karen A. Frenkel**

LOCATION: **New York, New York**

DATE: **30 January 2008**

FRENKEL: This is Karen Frenkel and today is 30 January 2008. I'm with Hao Wu, and this interview is the first session for our interview for the Pew Biomedical Scholars Oral History Project. And I'm going to ask Hao where and when she was born, please.

WU: I was born in Beijing [China] in 1964 [on] 23 May, the hours I don't know. [laughter]

FRENKEL: Yeah. We don't have to know the hour. That's okay. What kind of neighborhood did you live in and what were your parents' occupations?

WU: Right. So, my parents were professors in universities. Where did we live? We lived in, I guess, the faculty housing, so our neighbors are from the same university.

FRENKEL: What were they professors of?

WU: Physics, actually.

FRENKEL: Both of them?

WU: Physics…right. They were classmates, my parents.

FRENKEL: And did you have siblings?

WU: Yes, I have a brother who's two and a half years younger. We were very close while growing up, actually. It was good to have him. [laughter]

FRENKEL: Is he older?

WU: He's younger, two and a half years younger.

FRENKEL: How much of your parents' professions did they bring home with them, and what was the talk over meals like?

WU: Talk over meals. You know, I really don't remember talk over meals. But, I think, we [knew] what they work[ed] on….I guess. I mean, they teach physics. That we [knew], I think. Oh, I think, they d[id] a lot of work at home. They prepare their teachings at home. Oftentimes they bring their work […] home. That's probably how we got to know that. Yeah, it's pretty vague, but we [knew] one way or another what they [did].

FRENKEL: Well, what areas in physics were they doing research in, or were they…

WU: Mostly teaching, I think, at the time.

FRENKEL: Mostly teaching.

WU: Well, at the time, there's really, you know, not much research going on in universities. My dad did some research, and those were, I think, on semiconductors. He actually built the…probably around the first TV. Actually at home we had a TV that he built with his own hands. But my dad died very young, so I actually didn't really have an extremely clear picture of him to some extent. I was twelve when he died, and that was all related to the Cultural Revolution because my family…my father's side at least…let's see. My grandfather is a chemist. He's actually a fairly famous chemist. He founded the [Chinese Chemical Society].

FRENKEL: What was his name?

WU: His name is Cheng Luo [Wu].

FRENKEL: L-U?

WU: C-H – no, C-H-E-N-G L-U-O, and Wu. Yeah, and also my grandmother is also literate. She's actually very literate, although she never worked. But she's an intellectual woman. She writes poems, those kind of things, for fun I guess. [laughter] So my father's side had six siblings, right? Three of them were old enough to come to [the] U.S. before 1949. That was before communists took over the country, right. So, three were in the States and three other siblings were…the three younger ones got stuck. [laughter]

So, because of this relationship I think with the U.S. through the siblings and also my grandfather who used to work for Guo Min Dang [Kuomintang], you know, the previous government. He used to work for the previous government. He was some kind of head of the Department of Measurement…some kind of…I'm not sure how to translate it.

FRENKEL: Standard, perhaps.

WU: Standards and Measurements, something like that, yeah. He actually converted the metric system with the Chinese system. So, you can still find the citation [to] his book at the back of Chinese-English dictionary.

FRENKEL: Interesting, very interesting.

WU: Yeah. So, I think because of all these things my father's family were considered, sort of…bad. Well, you know, the sentiment is that at least in the early 1960s and late 1950s the government has this movement against the intellectuals, right?

FRENKEL: Right.

WU: Right.

FRENKEL: I see what you mean.

WU: Right. So they were considered bad. And my dad was eventually…he really didn't do anything wrong. […] What my mom told me was that somehow he scribbled…during one of these boring meetings; I guess he scribbled some names on a sheet of paper and they, I don't know…extract[ed], whatever…something out of that scribble and [said] that he [was] an antirevolutionary, or he [was] antigovernment, [or] things like that. So, he was considered that for many, many years.

FRENKEL: Oh.

WU: Yeah. When I was five, our whole family had to go to the countryside in the Jiang Xi Province, in the countryside, to…I guess the aim is to mingle with the farmers and to work as a farmer so that you get—I'm not sure what the word would be. You improve yourself by […].

FRENKEL: With the common man to get…

WU: Yeah, with the common man, right. Exactly…to somehow improve yourself by doing that. They did all the farmer work like growing wheat. [laughter] Oh, no, not wheat. It's probably rice. Actually, I think it's rice. Rice I think grew in water…rice [is], sort of, almost water, yeah. So, my dad also raised pigs.

FRENKEL: How long did you have to do that?

WU: I think they stayed for two years. The kids came back I think within a year or even less than a year. I'm not sure. Because my parents thought the conditions were not so good for the kids, they send us to the relatives in…my mother's side's relative in Zhang Jia Kuo [China], which is a city not too far from Beijing [China]. That's where my mother's family…

FRENKEL: So, what was it like for you to be transported from your home to the countryside?

WU: For me…I don't remember being either sad or not sad. It was […] a benign experience. To me it was […] a benign experience. I think my parents probably tried to shield a lot of stuff from us, because I didn't know anything [about how] my dad […] consider[ed] […] when I was young. I didn't know anything about those things. Those all came later.

FRENKEL: What was the school like?

WU: No school. I didn't go to school.

FRENKEL: No school for you?

WU: I didn't go to school […] there. But I was also…before school [age]…in China you go at seven.

FRENKEL: Oh.

WU: Yeah, at seven […]. We go to kindergarten. Well, kindergarten is like a day care. I would say we went to day care that's organized by the university.[…] And we were all in the same class. My brother and I [were] in the same class. There's just no age. It was just everybody I guess all together.

FRENKEL: Kind of a nursery.

WU: […] I guess, yeah. We [were] all together. Yeah, I remember that.

FRENKEL: So, then you were separated from your parents at Zhang Jia Kuo.

WU: Right.

FRENKEL: For how long?

WU: I would say for two years. I think it was about two years, because I went to first grade in Zhang Jia Kuo for the whole year. Actually, [I was] not only separated [from] my parents, I was also separated [from] my brother, because my brother went to my grandmother's house and I went to my aunt's house. I guess they couldn't take…each family could not take two. There was just too much work.

FRENKEL: What was your aunt's house like and what was your aunt like?

WU: It was great. Actually, it was great. They treated me so nicely…everybody. My aunt had two daughters and one son, and they [were] all older than me. My mother is the youngest child of the family. So is my father…so, they were both the youngest. They treated us [better] than their own, really. Actually, it was a very good experience, except the place is really cold.

FRENKEL: Oh, it's cold?

WU: It's very, very cold. I actually had a stomach ache every day, every day.

FRENKEL: What did you have…[a] stomach ache?

WU: Stomach ache, yeah. At wintertime I [had a] stomach ache every day.

FRENKEL: From what, the food?

WU: The cold, the cold.

FRENKEL: From the cold?

WU: Yeah, just from the cold. I think maybe there are just some…I also have some stomach problems probably. It's probably some kind of irritable bowel, you know; [that] kind of things that you don't know what the cause is, yeah. Things like that, yeah. So my stomach has always been sensitive I guess. Also, the food. Well, at the time we don't have a lot of refined…well, at least in Zhang Jia Kuo most of the grains are not refined grains, and those were, in general, tougher on your stomach. A lot of the food, the refined food at least, [was] rationed. Oh, when they [had] whatever they [had], they [gave] it to us, so I actually had the chance to eat more of the refined food than my cousins because they're more used to…whatever.

FRENKEL: They grew up on it.

WU: Yeah, yeah.

FRENKEL: So, you were there in school for a year or so.

WU: For a year, yeah.

FRENKEL: What was first grade like?

WU: It was wonderful, actually. It was great. Everything was great. My friends were great. Everything was great. School was great. I was the best student in the class. Everybody loved me. [laughter]

FRENKEL: What could be bad?

WU: Yeah, yeah. I really had no bad experience. I don't remember anything bad, actually.

FRENKEL: Could you communicate with your parents at all during that year?

WU: I mean there's no phone. I don't remember writing to them, actually.

FRENKEL: Did you hear from them?

WU: I don't remember either, actually. I don't remember either. Somehow I, sort of, settled in [at] my aunt's house. I actually don't even remember missing my parents. It's really amazing, now [that] I think about it. I don't remember any of those things.

FRENKEL: Well, you were very young.

WU: I was very young. I don't remember feeling that that place was worse than Beijing or any of those things…none, actually.

FRENKEL: And you and your brother were removed from the countryside because it was so harsh there?

WU: Yeah. My parents decided to take us back.

FRENKEL: Was it very cold there as well?

WU: No, no, no. No, not cold. Just the living conditions…everything else.

FRENKEL: I see.

WU: [There was] a lot of disease there, because I think that there [were] lots of parasites. Actually, when my father died the doctor was suspicious of some kind of parasites from [the] pig…during the years he was raising the pig. But my mother didn't want to have [an] autopsy, so we still don't know. We don't know how he died, actually.

FRENKEL: I see.

WU: Yeah. He just had this persistent fever for months.

FRENKEL: And how old was he when he died?

WU: He was forty.

FRENKEL: Forty.

WU: He was forty, yeah. I was only twelve.

FRENKEL: Okay. So then you were reunited back in Beijing?

WU: Yes.

FRENKEL: Did you just travel to Beijing…your aunt brought to Beijing?

WU: No, no. My parents took us.

FRENKEL: They came and picked you up?

WU: Yeah. I think my mom probably.

FRENKEL: What was the reunion like?

WU: I honestly don't remember. My mom sometimes tells us that every time…she [did] visit us once in a while…I think even when she was in the Zhang Jia Kuo countryside […], whenever she [had] a chance I think she came to see us. She tells us every departure was teary and everything else. And I don't remember. I really don't remember.

FRENKEL: So, then they were punished for two years.

WU: Right.

FRENKEL: And when the punishment was over, they came back…

WU: They came back.

FRENKEL: And they could resume teaching physics?

WU: Yes, they did. […]

FRENKEL: They had Ph.D.s in physics?

WU: Oh, no, no, no. They just had…actually, nobody had Ph.D.s at the time; […] they just had a bachelor's degree.

FRENKEL: B.A.s.

WU: Yeah, B.A.s. Actually, even during their B.A., [toward] the end of their bachelor's degree [program], the movement [had] already started, the movement of anti-intellectualism, so in school they probably only really studied for two years or something. After that, they were put into useless research labs and [were] not really learning anything. It's all part of this government thing. Yeah; it [had] already started at the time when they were still in school.

FRENKEL: So, that was in the late 1950s you said?

WU: Late 1950s to early 1960s […] right.

FRENKEL: Okay. So, tell me about having been in this anti-intellectual period during their youths. What was the family's attitude towards education when you started to go to school?

WU: Yeah, no…good. I think the thing that my parents kept on telling us was that there are a lot of things you can't control, but one you can control is what you learn, so that was really deep in my head. […] They were just saying [that] when you finish school you may have to go to the countryside and all that, but if you do well in school, all those things, nobody can take [that] away from you. So we always had this positive attitude towards education, I think. Even though they were punished for being like that, they never said you should not learn or anything like that […], so both my brother and I were very good in school. And it's always self-motivation I think, because I don't remember my parents actually telling us, "You have to do homework," and this and that. It always was finished.

FRENKEL: You know, we didn't talk about your mother's side of the family.

WU: Right. My mother's side…four kids. My grandfather is a merchant […] whom I never met…actually passed away before I was born. And my grandmother lived to her nineties. She's illiterate; she couldn't read.

FRENKEL: She's still alive?

WU: No, no. She died in her nineties. [She was] this little illiterate woman with her feet…you know the Chinese…

FRENKEL: Bound feet?

WU: …women [with] bound feet.

FRENKEL: Wow.

WU: Yeah, with the bound feet. Whereas, my grandmother on my father's side has big feet […], flat feet, because she didn't believe in those things. My mother is the only person in her family who went to college.

FRENKEL: Out of how many?

WU: Out of four…out of four. Actually, from what my mother told me, the family wasn't really supporting her at all; […] there were two boys and two girls, so the family were trying to get the boys to college, to school and this. The boys didn't want to do it, I guess, so they didn't do it. My mother [was] somehow just really good. So, eventually she got fellowships to go to college. So that's how…the family wasn't going to pay for anything, even just her living expense[s], because college in China is free. You only pay for the living expense[s].

FRENKEL: Right, and the food, I heard.

WU: Just the food. Yeah, living expenses…pretty much the food, yeah.

FRENKEL: So, for a woman to do science…to be in physics in that time, was that unusual?

WU: It's very unusual I think […]. She went to a sleep-away school even before college, I guess, with everything paid also. So, the family wasn't really part of this whole thing at all. She went [to] it herself. That was Zhang Jia Kuo, a small place, right? It's a small city. So, she went to whatever her primary and secondary education were […]. Very few people from the school went to college in Beijing, so she actually was able to get into a college in Beijing. Well, the reason that she could get the fellowship was because the only way they offer a scholarship is with the goal of your becoming a teacher. So, this is called Beijing Normal University.

FRENKEL: Normal?

WU: Normal. Beijing Normal University.

FRENKEL: For teachers.

WU: So, basically for future teachers. Even when she was…it must be high school or whatever, junior high or senior high […] already she went to this school that's destined for being teachers at the end. That's why everything's paid.

FRENKEL: I see.

WU: Right. So, that was her only choice, actually, because that's the only place she actually [could] get everything paid.

FRENKEL: Did you have the impression that your parents were content […] being teachers in physics, or did they have ambitions that were stymied?

WU: Well, my dad wanted to do research…that I know. Eventually, he did some research, but I'm sure it's not as much as he wanted.

FRENKEL: Did he publish?

WU: No, no, at the time, no. I don't think he published. I don't think so. But he worked for these big expos […] everything is sort of a show. It's like a show. Everything is like a show. So, there will be periods that […] the research would be towards showing something at industrial expo to show how great the country is doing, you know. It's all part of the pride or something of this country. It's like trying to do well in Olympics…those things. So, that's why my dad made the first TV and those things. Those were displayed in the expo. He worked really really hard on that. He actually was a believer [in] the communism. He really thought communism was good. So was my grandfather. That's the only reason he stayed [on the] mainland. When communist[s] took over, all the government went to Taiwan. He actually had to [flee].

FRENKEL: Your grandfather.

WU: My grandfather. And that was the big piece of news in the Hong Kong newspaper because he defected, right, in the sense to the old government. Yeah, they were supposed to be going to Taiwan and then he went…I guess he took the family to Hong Kong instead and he went back to the mainland. They think communist [government] is good for the common people. I mean the theory of communism is not bad, right? Everybody would enjoy a good life and things like that.

FRENKEL: Yeah, but they punished him for two years in the countryside.

WU: Yeah. But that was all before, right? 1949 was when the decision was made. The whole family…

FRENKEL: Oh, that was before.

WU: Right…stayed in the mainland, right. Yeah, I think he was never against the government. Only probably until the end…

FRENKEL: Who?

WU: My parents.

FRENKEL: Your father or your grandfather?

WU: My father. […] Also, my grandfather also suffered. It's really terrible.

FRENKEL: Well, that's why I said […] your father was sent away for two years for some…

WU: Yeah. After that, of course.

FRENKEL: …for some excuse. So, after that, did he change his mind?

WU: I'm sure he did, but he didn't tell us. I know there was some, kind of…sometimes I would hear them whispering and things like that, and I knew there was something going on, but not really transparent to us.

FRENKEL: I get it. Okay. So, tell me about the years in school when you thought you might become interested in science. How early did that happen for you?

WU: I would say all along in a sense. Well, my parents always stacked […] a lot of books at home. We have a lot of books. Even though they make very little money […] we always had money for books […]. A lot of books about…like I said, books about…sort of, encyclopedia kind of books I guess, the why book, why this, why that. There was a whole series of whys and we always had them.

FRENKEL: Chinese series?

WU: Yeah. […] So, I think…from early on certainly my parents were trying to influence us, I guess…not through spending a lot of time with us, because they don't have the time I think. They're always working, yeah. I mean from very early on, I started cooking, doing chores at home, shopping for groceries, very young actually, as far as I remember .

FRENKEL: How young?

WU: Certainly early teens, I would say.

FRENKEL: So, that was after your father died? You had extra responsibility.

WU: Oh, yeah. That could be why. But before that, I'm trying to think. Even before that, I think I started doing shopping certainly. I don't remember cooking, actually, but shopping.

FRENKEL: Did your brother help?

WU: No. [laughter] I don't think so, no, no, not really. Because foods are rationed—meats at least meats were rationed—also, when you go to a grocery shop, you don't just get…sometimes they have good meat, sometimes they don't have good meat. I was the one who always [had to] go to the shop, and sit there, and wait until they…when they take out a good piece, I [would] buy it, you know, something like that. Sometimes I would go through the lines a few times in order to get […] good meat. Because if it's bad meat…if it's all fat and things like that, I [would] go again. It's not like you can pick. There's not a lot of…

FRENKEL: [Choice].

WU: …[choice], yeah. So, I did a lot of those. I remember that.

FRENKEL: Since you said you didn't have a lot of money but there was money for books and your mother now was supporting you on one salary—one teacher's salary, I guess—did you have to watch every penny?

WU: Oh, yeah. We were pretty frugal definitely.

FRENKEL: So, it was hard…hard economically?

WU: Yeah. But I think it was almost a habit. I didn't really feel the crunch […]; [I didn't consciously feel] the crunch. I think just because we never were rich or it [had] always been like that pretty much. Although I was told we had a lot more money before the Cultural Revolution because my aunts and uncles in the U.S. were sending money to my grandma. Because I was young, I really didn't notice. I mean, what [did] I want when I was young. If I have a good meal…I really don't…yeah, if I'm full…I never had toys. That's true. But I never really…

FRENKEL: What about hobbies?

WU: Yeah, hobbies, hobbies. A lot of hobbies, actually, a lot of hobbies. But I only consciously remember my hobbies probably after my father died when I was a teenager.

FRENKEL: What were [they]?

WU: Younger than that, I don't remember. Well, pretty much anything. Anything I can get [my] hands on, I do it pretty much. Hobbies, okay. [In] summertime I swim a lot. Actually, swimming is very rare in China…not a lot of pool. But if you are part of the university, there's always a pool in the universities, so you get to swim. I remember swimming. I remember always eating a lot of food after swimming…always very hungry. Let's see. Hobbies. Reading, I guess reading. I was also doing Chinese calligraphy…drawing. I was playing violin.

FRENKEL: Violin?

WU: Yeah. I was never good.

FRENKEL: But you had lessons?

WU: Well, my neighbor was a […] no, no. There was no such a thing, actually, as the lessons. Very rarely, very rarely anyway. So, my neighbor knows how to play a violin so that's pretty [much] how I learned, from him. No, I didn't have to pay him or anything, yeah.

FRENKEL: Oh, that's neat.

WU: Yeah.

FRENKEL: Did you keep that up?

WU: And then in college I started doing guitar; […] that was the only thing I sort of know how to play at the moment. Violin is completely gone, completely gone.

FRENKEL: [laughter] Okay. Well, what did you read? Did you read many…

WU: Well, a lot of science. I think science was the most…

FRENKEL: Science?

WU: Yeah. Knowledge…mostly science I think because that's what we had.

FRENKEL: Are there any books besides the encyclopedias that you can think of that influenced you?

WU: I'm trying to think. It's mostly encyclopedias, so it's mostly…and then I know when I was in high school, I did a lot of math…a lot of math. But that was on my own initiative I think. My parents didn't buy those books for me. I bought them for myself. All kinds of math.

FRENKEL: Now you were not sent away to boarding school, it was your mother…

WU: My mother, but I didn't know.

FRENKEL: So, you went to high school in Beijing.

WU: In Beijing. Yes, in Beijing. I never left the family.

FRENKEL: Let's talk about […] high school then, because up until now we've been talking mainly about your formative years when you were…

WU: […] I did…maybe I can tell you something about my grade school after I had come back from Zhang Jia Kuo. Then I had to start from second grade [in] a class where all the faces were new […]. There was actually a little bit of a shock there…at least I remember. Everything went well with the academic part of it, but there was a lot of…that was my first experience with the little mini-society. One girl, or maybe two—at least two girls—I remember there were two girls who were really mean to me.

FRENKEL: Oh, you mean like a clique. When you say mini-society, you mean like a clique of girls?

WU: Clique?

FRENKEL: I didn't know what you meant by mini-society.

WU: Well, when I was in my aunt's house, everyone was nice and I had good relationships with everyone. But when I moved to the new school, these two girls were really mean to me. Well, one was the head of the, I guess, champion of the class. What's the word?

FRENKEL: President of the class?

WU: President of the class. She was the president of the class when I got into the class. And then I just…I guess I was doing so much better than her academically…as soon as I got in, I [became] the first…the thing is, in classes or in grade schools here, you don't really rate [rank] the students […] based on grades, […]. They don't really…right? […] I don't know if they consciously know who's the first, who's the second.

FRENKEL: No, not always.

WU: […] But we know very clearly because they always publicize…they show who got what grade and…from that young age. I don't know, but I was just always the first in the class. I don't know if it's just jealousy or something. And then also soon after that I was elected to the…not really elected, I guess appointed. [There] was not an election…not for my class, but for the school, some kind of school thing as the vice-president of the school…some kind of organization…I don't remember. Oh yeah. Student organization vice president or something like that.

FRENKEL: Oh, I see.

WU: Yeah.

FRENKEL: As a reward for being such a good student.

WU: Yeah. Actually, it was very amazing to me that the whole culture or this whole government was too anti-intellectual or whatever. But if you do well in school….

FRENKEL: [laughter] It's true.

WU: No, no. In China you are very recognized. No, it's really interesting…not that you could do…well in sports, you're not recognized as much. It's very different from here. Here it's all sports, right? And there it's actually all grades. If you do well…anyhow, so where was I?

FRENKEL: Well, we were talking about the mean girls.

WU: Oh, yeah, the mean girls. So, she was…she was really mean to me. And the thing is, I really didn't know how to cope with it. I really tried to please her…that's what I did; I really tried to please her. I tried to be her friend and it never really worked out. It was sort of a…when I look back, I felt like I was so weak that I didn't stand up for myself. I don't know. I guess I was trying to fit in.

FRENKEL: What about the second girl?

WU: The second girl was also mean. She was a friend of the…it's related. She was a friend of the other person as well. And she lives in the same complex as me. We're from the same university. I actually don't remember any details [of] how they are mean to me.

FRENKEL: That's okay. We don't need it.

WU: No, I really don't remember. No, I really don't remember. I just remember that they were mean to me. The thing is, my reaction was try to be nice to them.

FRENKEL: Were the boys nice to you or did they not like a smart girl?

WU: No, they didn't give me a hard time, no, no. They were all fine, actually.

FRENKEL: And what age are we now when they're being mean to you? This is still…

WU: I was eight. I would say eight to ten, […] somewhere around there. I was very young. I was really not standing up for myself, I know.

FRENKEL: I think you were probably too busy being a good student to be bothered. What do you think?

WU: It was bothering me. I know it was bothering me. And I was really trying to be their friend. [laughter]

FRENKEL: Did you study a lot or did everything just come easily to you?

WU: It [came] very easily. I don't know why, but everything came easily in school at least.

FRENKEL: So, when you're that good—when you're first [in] your class in elementary and what we call middle school here—do you then get sent to a special high school?

WU: Oh, yes, yeah.

FRENKEL: I know in rural parts of China other scholars told me that they did get sent to a special high school.

WU: Yes, yes, yes.

FRENKEL: Is it the same way in the city?

WU: Yes. After the grade school—so, probably after sixth grade—when you go to a different school. And that was the time when there should be…actually, at the time, things already changed. We have these exams. If you get good grades, you'll go to the best schools and things like that. Yeah. So, I could have gone to any one of the best schools there, but my parents chose a school that's good, but not the best. There [were] three classes, one would be non-rated, the other one is rated locally as good, and then the top is rated nationally as good. So, I didn't go to a school that's rated nationally as good because they were so far away. They were far away. My parents decided it's probably better that I just go to a school that I can take a bike, ride to the school; and that's what I did. I [continued] to be the best student in high school as well. There were actually two opportunities where I [could] also move out to another school. Basically my parents decided not to…for just the commute…it's too much. A young kid, too much. You get on the bus every day.

FRENKEL: So, instead you rode the bike.

WU: Yeah, instead we picked a school that's pretty good and I stayed there for the whole time basically.

FRENKEL: So, this is now around 1976?

WU: Oh, no. More than that.

FRENKEL: Or 1978?

WU: I went to school in 1982.

FRENKEL: 1982.

WU: 1982 is when I went to college.

FRENKEL: No, no. I meant high school.

WU: Oh, high school would be I would say 1978 to 1982 or somewhere around there. The definitions [are] slightly different. I think it's more like middle school and high school together for a total of, I think, five years, not six. I think five years.

FRENKEL: I see. What were your teachers like in high school?

WU: Also very good. Everybody's good. All my teachers loved me. [laughter]

FRENKEL: Did any of them mentor you in the sciences?

WU: Yeah.

FRENKEL: More than in other subjects?

WU: For me […] everything was a bit flat in the sense I was good [at] every class. Or just me or it actually was odd. Even in writing. I was good in English. I was good…so it was a confusing choice when I need[ed] to go to college because I enjoyed everything I did and I wasn't sure which path was my best choice […]. I actually went to medical school after high school. We go to these specialized schools right after high school…not after college. So, I went to this medical school that's the most difficult to get in[to]. That's the most difficult to get in[to].

FRENKEL: Right after high school?

WU: Yeah. It's called Peking Union Medical College. It's only, I guess, in China that's…it's founded by the Rockefeller Foundation. They only accept thirty students a year. It's a very

small college. But with an eight-year curriculum, it's like an MD/Ph.D. program. My parents, being physicists, I guess they really wanted the medical doctor in the family, and that's pretty much why I went to medical school. They feel like it would be good to have a medical doctor in the family instead of in the physical part of the world.

FRENKEL: So, you got that message through your mother…

WU: My parents, yeah.

FRENKEL: …about your father's wish as well.

WU: Yeah.

FRENKEL: Because by then he was gone.

WU: Right, he was gone. But I was also very curious [to know] how he died, why he was ill and nobody [knew] what [had] happened. [When I was in medical school I went to check his medical records. I dug out his medical record and I wanted to see it. Of course, I still couldn't solve the mystery. I really don't know.

FRENKEL: Oh, [I] see. Let's talk then about your curriculum in medical school and how hard you had to work, because I know that it can be grueling. And since you also had studied English, how much were you able to study what was going on in the rest of the world medically?

WU: Right.

FRENKEL: That's too many questions at once.

WU: Right. Okay, in college.

FRENKEL: Let's start with medical college.

WU: […] My college has a pre-med period which we actually do at Peking University.

FRENKEL: Oh, okay. I got confused. So, we kind of…you told me about the Peking Union, but you didn't go straight there from high school. There was a pre-med college…

WU: Right. But it's […] part of it.

FRENKEL: It was part of it. Okay.

WU: It was part of it. They collaborate, I guess […]. We were in the biology department, so we were totally integrated with the biology students there, except that we would leave after three years instead of four to go to a different campus where all the medical teachings [began]. College, college, college. [laughter] College [was] great. [I think the best thing] in college was the huge library. I spent a lot of time there […] Again, I [got] the highest grade in college. Somehow exams come really easy for me, but research is different; […] research is […] very different.

FRENKEL: Do you find that when you read something you just remember it?

WU: I just get it, I guess. I get it somehow.

FRENKEL: And memorizing. There's a lot of memorizing in biology.

WU: It's probably also a lot of memorization, yeah. I probably have a good short-term memory. Long-term memory is not so good I think. But I think a lot of it also is just the understanding. If I understand it a little bit…or understanding, plus association probably. I try to associate I guess what I read with things that I know, [and] that's how I memorize things […]. I got in [with] the high[est] grade, because you had to take a [National] College Entrance Exam to college. So, [I] got in as [the] highest grade in the whole school.

FRENKEL: To the preparatory pre-med, right?

WU: Right, to this college, whatever […]. I was actually also the highest in the biology department when I got in. [In fact], I was one of the highest in [the city of] Beijing in the whole of Peking; I was number five. It's weird we all know these things.

FRENKEL: Number five.

WU: I was number five in, I guess, a million in Beijing.

FRENKEL: In the whole university.

WU: In the whole…in the whole year, the college entrance, the whole college entrance exam, something like that, yeah.

FRENKEL: Wow.

WU: […] My parents [said], "See, you didn't have to go to one of those really tough high school[s]," […] Actually, I worked a lot less because I was in not the most rigorous school. I had a lot more freedom; I enjoyed [school] lot more I think. I had a lot more free time [for] doing a lot of math competitions, physics competitions, chemistry competitions. [In fact], I was supposed to go to the Math Olympiad.

FRENKEL: I see that. International Math Olympiad in 1981.

WU: Right.

FRENKEL: You didn't end up going?

WU: I actually didn't end up going because my…at the time, [I had] already decided to go into biology—medicine/biology. And my biology teacher had some influence, [a great deal of influence] on me because he was a pretty famous biology teacher […]. He made these biology movies; he makes these documentaries about biology movies.

FRENKEL: Wow.

WU: He got me into doing that with him, writing…

FRENKEL: Writing scripts?

WU: Scripts, yeah. Writing scripts about those movies. I lost the tape. Actually, I had a movie with my credit on it, a little documentary.

FRENKEL: What were they about?

WU: About animals […], marine animals.

FRENKEL: Marine animals?

WU: I don't know about marine animals anymore…but about marine animals, yeah.

FRENKEL: Now where were they shown?

WU: I don't know. But we made it and it was…I don't know. I think it was shown on TV. I also had a copy of it. So, that summer he took me to the sea city of Dalian [China]…no, not Dalian, Qindao [China] Have you heard of Qindao?

FRENKEL: No. Can you spell it?

WU: it's Q-I-N-D-A-O. Qindao is a city on the shore. Qindao. We went there to basically collect specimens; that's what I did that summer. It was a conflict.

FRENKEL: That must a been a hard choice in a way.

WU: It was a hard choice, yeah. It was a hard choice that I. Looking back I would have gone to the Olympiad.

FRENKEL: Oh, you regret…

WU: Yeah. Well, I was influenced by my parents, I think, because I was supposed to be. [I was also influenced] by this teacher who's really, really try to get me doing things with him […].

FRENKEL: What would you have done at the Olympiad? What goes on at the Math Olympiads?

WU: See, I was the only one…had I gone there, I would [have been] the only one. I [would not have known] anyone [there] because. […] In my school, there were two students who tried to [go to the Math Olympiad]. I have a friend [who] ended up going [in]to math as a major. He's [a] mathematician, [-] he's here in [the] U.S. as well - […] but he didn't make it. He was really sad that he couldn't make it.

FRENKEL: He didn't go to the Olympiad either you mean?

WU: He didn't make it because you need to…

FRENKEL: Oh, he couldn't get in.

WU: He couldn't get in. I got in and I could—I didn't want to—well, eventually I didn't go. Had he made it, I probably would have [gone] because we were friends and least we [would have had] two…we [knew] each other. because we actually [had] to go to Shanghai [China] to a different city to do the Olympiad. So, [for] all [those] reasons I didn't actually end up going.

FRENKEL: Well, what happens at Olympiads? I don't know anything about Math Olympiads.

WU: Right. First you train. […] You collect all the [top students] from different cities, and then you train. You take classes. They put all these students together. They will train you. And then eventually you take the test.

FRENKEL: Oh, it's a test.

WU: It's a test, yes, yes. It's a test, yeah.

FRENKEL: To become a mathematician and professor maybe of math? What do you do once you pass that test?

WU: It's just an honor. There's nothing else.

FRENKEL: It's an honor.

WU: It's just an honor because internationally you compete with everyone.

FRENKEL: So, it's international.

WU: Yeah, yeah. It's a test. That's all. It's a test […]

FRENKEL: Wow. And the whole international thing was in Shanghai [China]?

WU: Yeah, it was in Shanghai.

FRENKEL: Was money a factor in getting to Shanghai?

WU: No, no. I don't think so at least. Not that I remember.

FRENKEL: It's just that you felt you had to go to the biological [track] because that was towards medical school.

WU: Exactly, yeah. Exactly. That was the only reason. But in a way, ironically, I went back to what I am doing…biophysics. [cell phone rings] So, I'm sort of…sorry.

FRENKEL: I'll pause us.

WU: Yeah, one…

FRENKEL: Okay. We're back on after a short break. So, after that summer making documentaries which you, kind of, regretted, then you had one more year of preparation before going to the medical school.

WU: Yes, right.

FRENKEL: So, were you continuing to work with the biology teacher who made the documentaries?

WU: A little bit, yeah.

FRENKEL: What was the final year like?

WU: The final year was just prep for the exams. Mostly just prep for the exams. It's exams here and there in every subject. […]

FRENKEL: All science, right at this point.

WU: No, no, no. Actually, the entrance [exam] also includes English as well as literature or humanities…science, including history; it's packed into one. English is separate, but all the humanities [and] science are packed into one. So, you'll actually have to write. You have to write essays in your exam. The subjects were, if I recall correctly, […] math, chemistry, physics, humanities, science, English, and communist history. […] I think that was a special subject.

FRENKEL: And how did you score on that?

WU: I don't remember. Pretty well [laughter]

FRENKEL: [laughter] I figured.

WU: Even though I didn't really…[laughter] But I […] did the best in math. I did really well in math. I got all the extra credits in the…I did better than the students who ended up being a math professor here.

FRENKEL: So, tell me, when you have had this incredible, unblemished record of being first in your class…fifth out of millions… does it go to your head at that age?

WU: I think it does, yeah.

FRENKEL: What was it like for you? What kind of a person were you when you were constantly exceeding everyone else?

WU: Probably I was [cocky] quietly. Cocky, but [quiet]. Because at a very young age I had this notion that I have to […] hide a little bit in order to have friends. That was very clear in my mind that I had to do that. For many years I was always the one…if I'm with my girlfriend, if we do something together, I always try to pay. I always do those things. I try to please. I'm really a pleaser. I was really a pleaser. I try to please for many, many years. I think I'm getting a little better now, but I still see that in me that I sometimes will go out of my way to do things that I really don't need to…or I really should think about myself first and sometimes I still don't. Like I say yes to too many things. I'm way too busy, this kind of thing […].

FRENKEL: […] kind of an apology for being brilliant [but not] quite?

WU: Not quite…but to some extent, yeah. […] I mean part of it was I always feel like, oh, maybe I'm not going to have a boyfriend. [laughter]

FRENKEL: Well that was my next question, because you spoke only of girlfriends.

WU: Yes. Well, in general, everything happened a little later in China…at least [for] my generation. Now the new generation [is] different […]. There's one boy I liked in my class who sat next to me. So, he's a handsome guy. That was the only thing. We didn't go out. There was no physical thing or anything, but it was just […] infatuation, I guess. He also plays the accordion very nicely. He went to a medical school as well, but a different medical school. He was in the band there. We didn't have any contact after, but it was just some thing. It wasn't developed or anything.

FRENKEL: Yeah, a crush.

WU: Yeah.

FRENKEL: So, 1982, when you entered medical school, you were eighteen, right.

WU: I was eighteen, yes. Actually, my parents made sure that I wasn't too young when I graduated because they were worried that I'd have to go to [the] countryside. So, even though I was doing so well, I never skipped. I didn't skip any grades or anything like that. They wanted us to…they want me to be old because then they think if you go to [the] countryside, you can take [it] a little better. They want me to be mature I guess, yeah.

FRENKEL: So, you might have been sent to the countryside if you had graduated a little earlier?

WU: I probably would […] yeah. The college was […] revived in 1990…no, 1977. Wait…the first year that you have this college entrance exam was in 1977. Before that, college students were sent by the government…so, it's not through exam. You have to be doing well with the communist party. You should be a member of the party. You should be leader and whatever, [and] then they send you to college. So, 1997 was the change. 1977, I'm sorry, was the change. I went to college in 1982. Before that, of course…my parents were still worried about everything. Actually, even in 1977, they check[ed] your background to see whether you're qualified to enter the exam because if your father is a bad person or whatever, you're not allowed.

FRENKEL: It would count against you?

WU: Yeah. That's…so, my father's name wasn't cleared until after I was in college.

FRENKEL: So, it could have counted against you.

WU: It could have counted against me, yeah. It could have. Actually, my mother remarried someone who…she made sure that he had a clear background. […] At one point when I was in high school, I changed my name to his last name.

FRENKEL: Well, I was wondering about that because you give a family name of Chang Wu.

WU: Yeah, I am Wu.

FRENKEL: No, but your grandfather's name was different.

WU: No, no. Cheng Luo Wu.

FRENKEL: Oh, so the change you made was temporary?

WU: Cheng Luo Wu. Yeah, it was temporary. So, we changed into a different last name when I was in high school for a little period.

FRENKEL: I thought that because of the middle name. I thought Lo Wu was the last name. It's the middle name.

WU: Wu is still the last name. And then after my father's name was cleared, we change it back. Actually, it was never registered as a change. […] In school I was just using a different name. Nothing was very organized. It's funny that you could just change a name without registering anything. And then eventually…I guess on our personal ID it'll always be Wu. So, it's never changed officially, but in school I was…

FRENKEL: But it did help…but it was changed in school and it helped you be able to go on to medical school because of this potential threat that your father would be considered bad?

WU: Actually, no. I think I got the timing wrong. No, no. I think my father's name was cleared before I went to college, yeah, before I went to college, because I was entered as a Wu. Yeah, I was entered as a Wu.

FRENKEL: Uh-huh. But you must have known people […who] had to change their name[s], right? This must have been something that other people did, right?

WU: Not personally. I don't know anyone…

FRENKEL: But your mother did probably because she, kind of, anticipated it?

WU: Yeah, it could happen. But not a lot of people I know had their parents die so young and remarry. I actually don't know any other case.

FRENKEL: Okay. By the way, what's happening with your brother at this point? Did he go on to school? Was he also doing well in his class like you?

WU: He was doing well, but not as well as me. I think it's just partly being a boy. [laughter] It is true. I remember this. His teacher will say that he's too absent-minded in his class. He does well regardless. But he's like…in the class he would be looking outside. I guess he's probably bored and doing those things. He's still doing well, but he wasn't like me, never made mistakes. I never make little mistakes. Yeah, it was just weird. My brother does. He does. He'll get 99 [percent] instead of 100 [percent]. No big difference. [laughter] I tell my kids because I see my kids making the same mistake. They do.

FRENKEL: Like their uncle?

WU: Like their uncle, yeah. They make tiny little mistakes…two plus two probably they end up to be a three instead of a four…just little things that they do. I figure that's probably a boy thing. They just…

FRENKEL: That's very funny. Okay. Let's go on to medical school and tell me about this experience […].

WU: Right. Starting from I guess the pre-med…there is a pre-med part, right, Peking University.

FRENKEL: I thought we were talking…

WU: We talked about that. Okay. And then we left…

FRENKEL: I'm talking about the first year of medical school.

WU: Okay so, after those three years in Peking University, right?

FRENKEL: Right. Right, those were the ones where you took the exam. You had already taken the exam for medical school.

WU: Right, and then I went to the…the first year was in Peking University though.

FRENKEL: Oh, I see.

WU: Yeah. It's a pre-med. It's very confusing.

FRENKEL: Once you are officially in the medical school program, if you can talk about those remaining years, because I know that you chose to not complete it. And I'm interested in knowing why and what it was like.

WU: Yes, okay. So, that was after…so, after the three years, we went to the medical campus and we started taking real clinical courses, physiology, circulation, anatomy, things like that. I enjoyed the classes, actually, all the class[es]. A lot of the classes were taught in English. That was the only school that could do that.

FRENKEL: Why'd they do that?

WU: Well, it's a tradition because it was founded…

FRENKEL: Oh, because it was [founded by] Rockefeller.

WU: It was Rockefeller, yeah. In the old days, they also had maids. [laughter] Sorry. Not anymore.

FRENKEL: Not when you were there. They didn't have maids when you were there.

WU: No, not after the Cultural Revolution. The college really was terminated for many years in the middle because of the Cultural Revolution. It was restarted in 1980. So, I was the third class, I guess, there. Yeah, so a lot of the courses were taught in English. We started seeing patients and all that. But then we had a little break […] - a one-semester break to do research. That's what happened. That's when I jumped the ship…yeah. So, I went to immunology and biology lab in [the] Chinese Academy. I guess, Chinese Academy of Medical Sciences which is right there actually. It's part of the…we're right next door. It's part of the university. The research lab is right…we live upstairs in the dorm. They were just downstairs. It was as close as that. So, I did research there. I actually published two papers.[1] That's when I decided to come to the states […and] do a Ph.D. instead.

FRENKEL: Well, how do you get into this immunology biology lab? Could anybody just volunteer to work in the lab? How did that happen?

WU: Well, that year…basically, everyone takes a break, everyone. So, that year it's part of the curriculum to do research.

FRENKEL: But there must have been other labs.

WU: Yes, yes. I went to the lab…well, through talking to the seniors and what they do, what they like, and talking to the professors…there was no true rotations to the labs. But you just, sort of, you go talk to the professor and see what kind of project they have in mind for you.

FRENKEL: So, what appealed to you about immunology and biology?

WU: He was studying lupus. He was doing lupus, [and] I thought that was cool.

FRENKEL: Lupus is [an] autoimmune [disease].

WU: Autoimmune, yeah, autoimmune disease. He was studying lupus. I think partly is a little bit arbitrary, but I found it interesting. So, I wouldn't say that lab would be the only lab that I go to, right? But I guess through the talking to other students who had gone through this, I decided that would be the lab that I go to. But it's not like I have at that time […] passion in immunology or […] because everything was very new to me.

[1] L. Zhu, H. Wu, Y. Dong, "Establishment of a cell sorting technique with a flow cytometer," *Acta Acadmeiae Medicinal Sinicae* 10 (1988): 386; L. Zhu, H. Wu, Y. Dong, "Phenotype analysis of T lymphocytes in SLE patients upon flow cytometer," *Acta Acadmeiae Medicinal Sinicae* 11 (1989): 1.

FRENKEL: So, you had some choices, and […] just figured you'd try this out?

WU: I would try this out, yeah, basically.

FRENKEL: And two papers were published in one semester…as a result of one semester?

WU: Yeah, two semester[s].

FRENKEL: Oh, you went back to them for a second semester?

WU: Oh, no, no, no. Half a year. I guess it was […] half a year […]. No…one semester, I guess.

FRENKEL: What kinds of journals were they published in?

WU: Oh, Chinese journals. At the time they just acquired the cell-sorting machine. It was actually the first one in the nation. Maybe that's partly why … I'm not sure actually … I don't remember exactly why I chose there. I was involved in setting that up and collecting […] blood from a sheep. We went to a slaughterhouse. I don't think a slaughterhouse. Somewhere we can get the sheep and collect blood. We also collect our own blood.

We also donate our own blood, separate all the cells, staining the cells and then do the flow cytometry, used the cell sorter. Then I went to a meeting, the international meeting of Biochemistry. I didn't register. It was just a meeting that's in this hotel that's very close to where I live. But it's one of the few international meetings at the time that's…nowadays, you have a lot more international meetings. But at the time, you don't really have a lot. So I went to this meeting and just went to listen to the talks. And I heard my professor talk. Michael Rossmann was my Ph.D. advisor. He gave a plenary session at the meeting, [and] that's when I got really fascinated with structure biology. He showed the structure of a virus. And then because I [recognized] the technique that's being used to study the structure. It's like physics. […] Part of me never really left that part of the…my love of those things, so I actually really tried to talk to people [who were] in that field in China. I got a book trying to see what the heck is this thing x-ray crystallography, [and] eventually I decided this probably would be a good choice for me because I know some medicine and this is like applying some physical technique to medical problems.

FRENKEL: After his talk, you got a book on crystallography?

WU: Right.

FRENKEL: Did you introduce yourself to him?

WU: I did. I introduced myself, and he said, "Oh, you should apply."

FRENKEL: What did you say to him?

WU: What did I say? I guess I just…I don't remember. He remembered more. Actually, it's funny that he actually remembered a lot. He said I was wearing this red dress; [that I] went to talk to him and [said], "I enjoyed your talk, […] What's the possibility [of] going to your university and work[ing] for you?" I guess he just said, "Just apply," and I did, of course, [enter] his curriculum, and then I went to work for him.

FRENKEL: Well, you make it sound so easy, but you had to get out of China.

WU: Yes, actually I did have problem with my visa. First I was on an F-1 visa, if you know the difference. Do you know these different visas?

FRENKEL: No.

WU: No, okay. So, I was on the student visa. Somehow because of the fact that I quit medical school, they think I have this…so-called tendency of immigration. Now I think it's understandable because of the…why do you want to quit medical school and go to United States?

FRENKEL: Well, what year was it that you quit?

WU: 1988. That's when I…

FRENKEL: And this is the beginning of student opposition and unrest anyway.

WU: Oh, yes, yes, that too, yes. because 1989 was the big event. It's actually lucky in a sense that I left right before that. My brother was still in China at the time. He was from Tsinghua University, which is the other university—next to Peking University— Tsinghua University. He actually went to Tiananmen Square. My parents were so worried because they [knew] the government [was] going to suppress it. My mom was begging him not to go because having gone through the Cultural Revolution, she had a better perspective. She had more fear, certainly, of what's going to happen. He came out right after that, 1989. He came to the states in 1989. That's when he graduated from Tsinghua.

FRENKEL: Okay. Back to you.

WU: Yes, yes.

FRENKEL: So, you left right before Tiananmen Square and you had this F-1 visa because they were worried you were going to defect.

WU: Right. Well, no, the tendency to stay in the States.

FRENKEL: And immigrate.

WU: Immigrate. Yeah. Why do you quit medical school and go…right?

FRENKEL: Was that realistic of them? Did you have that in mind?

WU: I didn't know they would have a problem with that. Usually when you have a full scholarship to come to the States, they usually pass. That was my impression anyway.

FRENKEL: You had a full scholarship?

WU: Yeah, of course. No, for Ph.D. program, it's usual you get full scholarships.

FRENKEL: From China.

WU: No, no.

FRENKEL: To go to the States, no?

WU: No, no, no. Scholarship [was] from Purdue [University], of course, from the university that I'm going to.

FRENKEL: So, when you applied to Purdue they gave you a full scholarship?

WU: Oh, of course, yeah. It's not difficult to get full scholarship for a Ph.D. program. I think it's not [but…] anyhow, I was refused visa. Eventually I had to change to a J-1, which required [that I] go home for two years […] in order to [come] back […]. So, when your J-1 terminates, you have to go back to your home country for two years in order to come back again if you want to continue to study doing your postdoc, for example, or something.

FRENKEL: I see. So, then you got the J-1. Then you had to come back for two years?

WU: Yeah. Well, but I didn't do that, because we got this amnesty, I guess…

FRENKEL: Because of amnesty because of Tiananmen.

WU: Yeah. Actually, I got green card right away through that.

FRENKEL: Well, let me just ask you an obnoxious question.

WU: Yeah, sure. Whatever.

FRENKEL: Why do you think Purdue wanted you so much? I mean you had three years or four years of medical school. You went up to a guy who gave a talk. Why did they want you so much at Purdue?

WU: Well, I don't know if they really want me so much. I was just part of the students who got admitted.

FRENKEL: Yeah, but you got a full scholarship.

WU: Oh, they all got…everyone in the Ph.D. program got a full scholarship. That's why I said Ph.D. program…

FRENKEL: Whether they were Chinese, or American, or not, it's all full scholarship?

WU: Oh, yeah, yeah, yeah. It doesn't matter. No, because you work through a lab. The lab will pay for you. Yeah, the lab will pay for [you]. No, it's not scholarship from the school.

FRENKEL: Stipend.

WU: Stipend, I guess. Yeah, stipend. Yeah.

FRENKEL: They paid for you to go to school there and work in the lab. Now I understand.

WU: Exactly, exactly. Yeah, it's all like that. Yeah, all Ph.D. programs are like that.

FRENKEL: Yeah.

WU: Right, yeah.

FRENKEL: Okay. Well, tell me about what it was like to go to Purdue and the cultural differences.

WU: Yeah, it's huge. Actually, I was late because of my visa problem. So, that was another thing that my professor always quote[s]. Every time he has a chance he'll quote […] I was late for all my classes. Again, I got there I think one week before the midterm exam, and I got first in all classes.

FRENKEL: On the midterms?

WU: On the midterms without taking any of those classes. I just took the materials, read them.

FRENKEL: In one week?

WU: In one week. I got all…so, my professor always quote[s] that.

FRENKEL: So, you were ahead of them?

WU: Well, I did well in the exams…that's all. I [got] the top grades.

FRENKEL: Yeah, but how many classes and how many exams?

WU: Well, three, three, three. Three core courses.

FRENKEL: And you absorbed in one week what they did in a whole semester?

WU: In half of a semester. A midterm.

FRENKEL: A midterm.

WU: So, some of the professors were saying, "Oh, my courses must be not so good because it's better not to take them." It was joking. So, I did well. I don't know. But there's one thing, I [have always been] good [at] exams […]. I don't know why. But the research was quite a shock actually. So, then I started working. [I] passed a lot of the requirement[s]. For example, organic chemistry [and] physical chemistry. Because, again, they take exam before that, see if you require those courses. I passed all of them. So, I actually didn't end up taking a lot of the courses.

FRENKEL: You were exempt.

WU: Right. I was exempt. So, I started working [in] the lab.

FRENKEL: This is still Rossmann's lab, right?

WU: Rossmann, yeah. So, I didn't really apply at any other labs. It was a pretty blind choice, but I don't regret it. I think it was a good choice. [I just went] with my instinct[s], kind of […]. Working in the lab is totally different. I was a disaster in a way, because [although] I worked okay during the little period of research in China, there it was […] completely different. I had to purify viruses…actually purify viruses. The first project I had was to take a plant, infect that with the virus, and then collect the virus and purify [it] through completely different techniques. I had a lot of trouble getting enough material actually to get it really purified and things like that. Well, I remember this really clearly because I was so pissed off. Because in order to solubalize the plant and whatever, I had to use urea basically. But if I use urea, somehow the bottles…those centrifuge bottles are not urea resistant. I don't know the details. So, then when they spin, sometimes you will get leaks into the centrifuge.

[…] I didn't know…well, I guess I [knew that], but I didn't think that was so important…so, another professor, not my professor, another professor on the floor [thinks] I'm destroying the centrifuge because my leak…because you get vacuum. You get a vacuum as you spin. So, if you're actually spilling out liquid, it's bad for the vacuum system, which I do understand. But I was pissed off because I was thinking, "Give me a choice. Tell me to do it a different way so I can actually do the experiment and not destroy anything."

FRENKEL: But the urea was in […] plastic test tubes instead of glass?

WU: Plastic. Yeah, it's plastic.

FRENKEL: So, it ate through the plastic?

WU: I guess. There was some kind of…

FRENKEL: That's weird. It's weird that they didn't tell you that.

WU: Yeah. So, he [thought] basically I should not be doing this experiment. I was so pissed off. I was just saying, "You should tell me what do, right? You don't have an alternative solution. So, now what do I do?"

FRENKEL: Did you say that to Rossmann or to the other guy?

WU: I said it to everyone. I was a tiny little student and he was a big professor. Actually, Rossmann was very understanding to me. But the other one really gave me a hard time. Anyway, it doesn't matter.

FRENKEL: How much time did you lose?

WU: I think I was pretty impatient and I really just want to get on with the work and do it.

FRENKEL: What did you lose, half a semester?

WU: Oh, no, no, no. No, no, no. It was just…no, not really. Because then Michael…Michael actually has always been very, very nice to me. He sent me to a different lab.

FRENKEL: That's Rossmann, Michael Rossmann?

WU: Michael Rossmann. He actually sent me to two different labs. So, one lab works on the purification of this virus. Actually, both labs work on purification of the different…I think they're slightly different strains of the same virus. One is [University of] Kentucky. So, I was there learning how to purify the virus. He sent me over there. That was actually when I first had Kentucky Fried Chicken. [laughter]

FRENKEL: [laughter] What did you think of it.

WU: It was great. I thought it was great. I loved it. Actually, I had a good time in that lab. Yeah, it's also my first experience of taking a tiny little plane because I had to go from Indiana to Kentucky. They take you on [this] little hopper. I don't know. It's not a jet.

FRENKEL: Propeller.

WU: Propeller. Yeah. Actually, I vomited…it was too bumpy for me.

FRENKEL: This is the University of Kentucky?

WU: Yes, University of Kentucky [Lexington, Kentucky] at Louisville [Kentucky], right? I think it was in Louisville. What are the other cities in Tennessee? No, no, no. Kentucky, right? It's just Louisville, probably. Is there another city?

FRENKEL: Probably in Louisville. I don't know, probably.

WU: Yeah, it's one of those cities. Yeah, it's probably Louisville.

FRENKEL: How long were you there?

WU: Oh, just probably a week, just a short time.

FRENKEL: And then the other lab?

WU: The other lab…he sent me to England, actually.

FRENKEL: Oh, that's great.

WU: Yeah. Well, actually what happened was this professor [Roger Hull] in England had the little scholarships—or fellowships, I guess—a little fellowship for six weeks for a student. So, I guess Michael talked to him and he decided to send me over for that.

FRENKEL: And that's when you got the other virus…the other strain?

WU: Yeah. So, I went to learn how to purify the other virus in the John Innes [Center] Institute…

FRENKEL: I-N-N-E-S Institute?

WU: Yeah, I-N-N-E-S. It's a place where a lot of plant research is done, because it's a plant virus. In Norwich [England].

FRENKEL: Norwich?

WU: Norwich, yeah.

FRENKEL: So, how did you like England? Let's start with that.

WU: I had a good time. I stayed with a family. I guess it's cheap housing basically, and everything was great. Everyone was nice to me. Except I didn't do a very good job, I think, with my six weeks there. I didn't really get the protocol to work very well […]. I don't know if it's really my problem or it's part of the problem with the protocol or something. So, that was actually sort of a hint to me that doing hands-on work is very different from taking exams. It's not like [theory].

So, for a very long time [I was…] scared of lab work in graduate school. So, this project…I never crystallized this virus. I made some attempts. But then eventually we had a visiting professor from China who started to work with me together on this project and we did crystallize it. I would say mostly to his credit. But low-resolution crystals…they're not good enough for structure determination. But meanwhile, I got on a different project which was mostly computational.

FRENKEL: When you came back.

WU: Yes, yes, no, that was probably after at least a year of struggling in the lab trying to purify this thing. So, I got a different project which is mostly computational and I did very well there.

FRENKEL: How did you get it? Did Rossmann give it to you?

WU: Yeah, he gave it to me. So, to some extent, it felt…the part that I'm good at is theory […], theory in the sense of computation. You feed something and it will come out as predicted if you do it right.

FRENKEL: Well, that's like math.

WU: It's like math, exactly, yeah. I really enjoyed writing the programs […] and [making] things […] work. Actually, the project that he gave me didn't work in one of the postdoc's hands, [but] I got it to work. It was just a big bug in the program; I found the […] bug.

FRENKEL: What language were you writing this in?

WU: Oh, Fortran.

FRENKEL: Fortran?

WU: Fortran, yeah. It is the only thing I know. Also, I [have] never take[n] any computer classes. I just learned it myself.

FRENKEL: You taught yourself Fortran here at Purdue?

WU: Yeah. I took a book and that's it.

FRENKEL: Well, wait a minute now. How did he know to just assign you a computational project if you had not had any computer science background?

WU: I don't know. I don't know. I don't know how that happened. I did really well in my crystallography class. I'm always bragging about myself. My first professor in crystallography class was not Michael Rossmann. It was somebody else who was teaching, who's still a good friend with me who remembered me clearly that I asked a lot of questions in the class. He [felt] that I have a really good understanding of those things. So maybe that's how Michael feels that I am someone who can understand the methodology. I don't know. But anyhow, I got the project like that, but without giving up on the other one. So, I was on both.

FRENKEL: Oh, you continued to work on that virus?

WU: Yeah, with the visiting faculty from China.

FRENKEL: And then did you use the computer program for…no, you said it was too low-res.

WU: Too low-res. We didn't solve that, yeah.

FRENKEL: So when did you first use your computer program to help solve a structure?

WU: I would say at least a year after I got there. I would say starting [in] 1990. No, no…1989 probably. I was there [in] 1998. I started on 1998. I think 1989 I already had…yeah, 1999, I already had…oh, either late 1989 or early 1990. I think that's when I got onto a different project.

FRENKEL: No, no, no. I mean like once you had created your Fortran program and debugged it…that program was then used to solve a structure. So, when did you try it out on an actual crystallized structure?

WU: No, no. The debugging was done together with trying to solve it. I was just doing the right controls, so that I know if I do this, it should come out like this, and it didn't. So, and then I tried to find out what's going on.

FRENKEL: Oh, that makes sense.

WU: It was all part of the thing together. It's together.

FRENKEL: You knew the structure and you were testing it.

WU: I didn't write the program. Michael wrote the program. But it's a new program, so whoever use[s] it need[s] to make sure everything is right.

FRENKEL: You debugged the program he wrote.

WU: I debugged the program he wrote, yeah. He wrote really most of it. I mean, I probably add[ed] little things here and there, but he wrote most of the programs.

FRENKEL: What crystal structure did you test it on?

WU: That was canine parvovirus.

FRENKEL: That's what you tested it on.

WU: Yes, yes. It was a dog virus, yes.

FRENKEL: Okay. You want to take a quick break?

WU: Yeah, sure, let's do that. Okay.

FRENKEL: Okay, we're going to stop for a while.

WU: Maybe I'll go check see how they're doing with my floor.

FRENKEL: Okay.

WU: It's just one block away, so I'll be right back. If you need anything…water, more water? I'll give you more water.

FRENKEL: No, I'm just going to turn this off.

[END OF AUDIO FILE 1.1]

FRENKEL: This is Karen Frenkel, and this is the second session of our interview for the Pew Biomedical Scholars Oral History Project, and I'm here again with Hao Wu. And during our break, we talked about some follow-up questions I had. I had mentioned that in looking at Dr. Wu's website, she has a[n extraordinary] gallery of photographs […] of very beautiful

landscape[s], and so I asked about that. Now she's going to tell me about her interest in photography, so we're going to go back in time.

WU: Yeah, in college I think everything is, sort of, new to you, right, and you just try to pick up whatever is along the way. Photography is one of the things that I did. I basically joined a photography class. Actually at the time I lived in China, most of the photographs were black and white. […] We took pictures and then we […] develop[ed them] in a darkroom ourselves. I guess, towards the end of it we started doing color photographs as well. […] we'd […] go somewhere and then we would take pictures and then we'd come back…as simple as that.

FRENKEL: What are some of the landscapes that you have on your website now? Let me just say for the record that they're just most exquisite carved out parts of the earth with huge pieces of rock that are standing up in flat places.

WU: Which one is that? What are you talking about?

FRENKEL: We have to go and look at it.

WU: Yeah, yeah, yeah. I'm not sure which one. But I have pictures of Keystone [Colorado], which I found to be really beautiful—the mountains in Colorado. So, I took some pictures of that. Also, I took pictures in Japan of the Fuji Mountain and things like that. What else did I take? I think that's all. Did I take more than that? I don't remember.

FRENKEL: Well, they were very beautiful and it made me think that it wasn't an accident that you became interested in crystallography.

WU: Yeah, it could be, yeah. Pretty pictures, yes.

FRENKEL: We were saying during the break that it is a very visual science.

WU: Right. Okay. So, that's my home, actually, so that's just that.

FRENKEL: So, Hao is now looking at…

WU: Oh, you're probably looking at the landscape.

FRENKEL: Yeah. I was looking at landscapes.

WU: Oh, the Tibet [China]. I didn't take those.

FRENKEL: All of that was Tibet.

WU: That was Tibet. This is all Tibet. This is…

FRENKEL: The whole photo gallery's Tibet.

WU: Oh, no, no, no, no. There's all these different pictures. But this is Tibet landscape. Maybe you went there. I'm not sure. Maybe you weren't there.

FRENKEL: Well, anyway it seems that I guessed right because…

WU: This I did take. I took the eclipse.

FRENKEL: This [is] the lunar eclipse of October, 2004.

WU: Yeah, I took that. Most of the pictures I put up here are social pictures. Really not…

FRENKEL: Then I was looking at another lab member's landscapes then attributed to you.

WU: Oh, really? Attributed to me?

FRENKEL: By mistake. I did.

WU: Oh, okay. Maybe, yeah.

FRENKEL: But that photo gallery…where's the one with the landscapes?

WU: With landscapes? Oh, this one? Tibet landscape? This is Tibet.

FRENKEL: Let's go back to that. Because maybe that's what I saw. But that's not the only one, right?

WU: No, there's more.

FRENKEL: Oh, okay. So, those are not yours.

WU: These are not mine. No, these are not mine. I didn't take these. I love them. That's why I put them up there. [laughter] They're beautiful. They're amazingly beautiful. My student showed this to me, actually, and I put it up here.

FRENKEL: Well, I was making the connection between the fact that you had them on your website…

WU: I love it though.

FRENKEL: …whether you took them or not with the fact that crystallography is so visual.

WU: Right, that's true. Yeah, that's definitely, yeah. No, I wish I [had taken] them.

FRENKEL: Okay. Let's also talk now a little bit more about the decision to leave China because that's a really big step even if you thought it was temporary at the time. And so, what you told me was that you went next door to this international conference, you heard Rossmann give his talk on the structure of a virus. Did you go to that conference thinking you might approach someone to come here?

WU: Yes, yes, absolutely. I already knew.

FRENKEL: How did you decide that you wanted to leave China for graduate school?

WU: Well, I've always known, I think. Partly because of my family - part of the family is here - I knew I [would] come to the States. But when has always been the issue. When do I come. Even right after high school there was some time I was thinking maybe I should come here for college. But anyway, I went to medical school. I guess the breakpoint was when I decided that I really wanted to leave medical school and do research. But I've always known that I want to come here…permanent or not.

FRENKEL: Did you approach anybody else at that particular conference?

WU: No, only him; I only approached him. That's all. […]

FRENKEL: Because of his talk.

WU: Yes […].

FRENKEL: And when you decided you were going to leave [a] medical school and come to the States, how did your mother and your stepfather react?

WU: They were very supportive. No, there was no objections. I mean my mother always knew that I will come.

FRENKEL: You had talked about it?

WU: Oh, yeah, yeah. It has always been there that at least I will come to get some training here, perhaps go back, perhaps not. But that wasn't clear. We don't know about that. But coming out [to the U.S.] has always been part of it.

FRENKEL: And you said that you had three relatives on your father's side. In fact, were they uncles or aunts and uncles?

WU: Aunts and uncles…yeah.

FRENKEL: Where in the States were they or are they?

WU: […] I have two aunts and one uncle. I had […] my first aunt was the oldest kid in the family. My first aunt is still alive. She's in L.A. [Los Angeles, California]. She's a Ph.D. in pharmaceutical chemistry. She's eighty-five or something. She's in her eighties. She lives in Granada Hills [California]. It's in the Simi Valley [California], at the Simi Valley [area] of L.A. [Los Angeles, California].

FRENKEL: I'm sorry. Did you say California?

WU: Yeah, near L.A., Simi Valley; […] she's still there. A few years ago when I went to see here, she was still working one day a week. She's a pharmacist.

FRENKEL: Wow.

WU: Because she didn't work after her graduation. She stayed home raising the kids. And she went back to work, I guess, after the kids were grown. […] she works as a pharmacist.

FRENKEL: And the other two?

WU: Oh, the other two. […] My second aunt [Hsiou May Wu,] I think that's the second in […] birth order…she died when she was forty-nine. Ovarian cancer. But she was also a Ph.D. in biochemistry. I guess she might be the closest to my field. She's a biochemist. She used to work at the University of Illinois at Chicago.

FRENKEL: Did they get their educations here also?

WU: Yes, yes.

FRENKEL: They all got their Ph.D.s here?

WU: Yeah, yeah. One [from] [University of] Wisconsin, the other [from] Baylor [University]…I think, Baylor, yeah.

FRENKEL: So, is that also an aunt? No, that's an uncle the one [is] at Baylor.

WU: No, no, no. The second one who died is also an aunt.

FRENKEL: Oh, and she got…

WU: Forty-nine, yeah.

FRENKEL: At Baylor.

WU: Yeah, Baylor. She's [at] Baylor, […].

FRENKEL: The other Ph.D….she was at the University of Illinois.

WU: Right. My first aunt is [at] Wisconsin. And then my uncle. My uncle is not in the biology-related field; he's in the engineering part of the family—physics engineering. He's an electrical engineer. He never got his Ph.D.. He has the bachelor's degree here from the United States as well. He caught TB [tuberculosis]. He caught TB when he was young. He never progressed into the higher degrees because of that. He actually met his wife in the TB hospital.

FRENKEL: In China though, right?

WU: No, no, no, here.

FRENKEL: He got TB and he…

WU: He got it here.

FRENKEL: He got it here?

WU: Uh-huh.

FRENKEL: Oh, wow. Because I was thinking how could he…

WU: I'm not sure. Actually, I'm not sure.

FRENKEL: I was thinking how could he get into the country with TB, because at the time it would have been difficult. I guess it didn't show up on any x-rays for a while.

WU: See, I don't really know. I don't know the timing actually. I know he had TB.

FRENKEL: That's okay.

WU: Yeah, whatever, yeah.

FRENKEL: I just asked about them because I thought that to leave and become a graduate student in not only a different country, but in a state in the middle of the United States might have been hard. And I wondered if you had had a chance to visit with your relatives at some time before or after you arrived here.

WU: After, of course […]. I was the closest with my uncle, actually, but he passed away just a couple of years ago. He was seventy-five, I think…

FRENKEL: Where was he?

WU: He was in Philadelphia [Pennsylvania]. Not in the city—in the suburbs of Philadelphia. My aunt is another. We used to visit for Christmas, things like that. We also used to visit…His wife was married before and had two children from the previous marriage, so I actually had four cousins from my uncle's family.

FRENKEL: That's nice.

WU: Yeah […] two daughters from the previous marriage, and then two sons from…So, when I was at Purdue, I used to go visit my cousin [in] Grand Rapids, Michigan, [but] I haven't done that for many years.

FRENKEL: Nice to have extended family in a new country.

WU: Yeah, […] that's true […].

FRENKEL: Okay. So, we plunged right into your very interesting work on the parvovirus after the frustration over the urea. [laughter] And then into the Fortran debugging. But let's talk about what the lab was like and what the atmosphere was. How did Rossmann run his lab?

WU: He has a pretty big lab. I think when I was there, at least twenty people. He has a really good secretary who's been with him for…God knows how many years. I think she was his first secretary. She just retired,…just retired. So, running lab…Michael is a really good crystallographer. He really spent a lot of time teaching us crystallography, so not only [did] he teach the courses, we also had […] Thursday night meetings in which we just picked a crystallography paper and discussed it and he would tell us everything he knows.

FRENKEL: So, he had a journal club.

WU: Only for the students. So, this is only for the students. Okay, maybe it is a journal club, or sometimes it's just the topic, say Patterson function or one of the topics of crystallography technique, or molecular replacement, or something. So, we really spent a lot of time learning crystallography, which is very, very rare in any school, especially nowadays. Nobody [is teaching] crystallography. I only give three lectures to the graduate students and there we took an introductory course, full semester course, and Michael Rossmann's advanced course. So, that's two courses plus all these additional things that he's teaching us.

FRENKEL: It was rare at the time to teach crystallography?

WU: To that depth, yeah.

FRENKEL: At that depth. You were expected to learn it on your own from textbooks? Is that why they didn't teach it?

WU: Yeah, in general; actually, it's even rarer nowadays to be taught crystallography to that depth because […] the software is so good a lot of people just use it without really understanding it.

FRENKEL: Oh.

WU: It's true, yeah.

FRENKEL: Does that have any negative implications for the interpretation of data?

WU: I think the positive outweighs the negative because so many labs are doing crystallography nowadays, not just crystallography labs. A lot of biology labs are doing crystallography with [this] advanced software, so, that's all good, but if you don't really learn crystallography, when [you] encounter a difficult problem it can be a hurdle there. So, I can't really say it's good or bad. It has both.

FRENKEL: That's interesting. So, but even back then it was kind of unusual that he taught it.

WU: So much, yeah. He's pretty hands-on. I would say he's very hands-on. He really enjoys talking to the students and postdocs, and that's pretty much all he does when he's in town, that is. He goes to a lot of meetings, extremely energetic; he is quite a role model in that sense. He's extremely energetic. He's seventy-seven or seventy-eight now.

FRENKEL: Now? Wow.

WU: Yeah. He's still running a twenty-some people lab. And goes to meetings and skiing with us…sailing—he's a very avid sailor—hiking. He's a typical European I think.

FRENKEL: He's European?

WU: He's European.

FRENKEL: Where from?

WU: He's German. He was born in Germany. He's Jewish. He actually had to go…he went to Britain, I guess, part of escaping the Nazis and stuff like that. So, he got his…

FRENKEL: He's a child survivor.

WU: Yeah.

FRENKEL: Was he on the Kindertransport do you know?

WU: I don't know.

FRENKEL: I'll bet he was. Well, that's a whole other topic.

WU: Okay. Yeah, I don't know about that. He got his bachelors degree and Ph.D. in Britain I believe. But I don't know remember where he got his bachelor['s] degree. But Ph.D. was…where would [it] be?

FRENKEL: Edinburgh [Scotland]? Glasgow [Scotland]?

WU: Glasgow. [University of] Glasgow, yeah.

FRENKEL: So, maybe that's why he had that contact where you went for six weeks in Norwich.

WU: Yes, yes. He had a lot of…in Norwich. Actually, he sent me to MRC [Medical Research Council] at the time just as a visit. Because he used to work for Max [F.] Perutz. As a postdoc, he worked for Max Perutz. See I was a first-year graduate student at the time. I really didn't recognize the significance of the trip. So, Max Perutz was my host to the MRC Labs. I met with him, Aaron Klug, who's another Nobel Laureate, and Richard Henderson, who was the director of the MRC, not at the time, but later. He was the younger generation. Henderson also worked with Michael Rossmann.

FRENKEL: I see.

WU: Yeah. I didn't a take single picture. I was so sad.

FRENKEL: You didn't know. You were new.

WU: I was naïve, yeah.

FRENKEL: So, he was hands- on when he was there but he was not often there apparently.

WU: Yeah, I think half the time he's probably [away]. But he is very hands-on; he wants to know what's going on. He has this enthusiasm, yeah. [Whenever I met with] him, he's like always excited. Make you think he's really enjoying what he's doing.

FRENKEL: It sounds like it was infectious

WU: It is…yeah, definitely.

FRENKEL: Now shortly after you came, because you came in 1988. A year later we had the uprising and the events of Tiananmen Square which you already mentioned your brother was involved in. I would just like to hear your thoughts about…your feelings about what was going on there while you were away. Tell me what went on [in] your mind.

WU: I think…having grown up [in] a family that's sort of accustomed to […] government […] oppression […], I wasn't surprised. I was just saying, "Oh, gosh." I was just […] thinking…it didn't take me [by] surprise what the government did […]; I was worried about my brother definitely. I was trying to call, [but] it couldn't go through for me. Oh, let me tell you when I heard the news. We were on vacation with a bunch of college – there are a lot of Chinese at Purdue, in any college—actually in the Ph.D. program. We were…where were we going? I'm trying to think. We were on vacation somewhere and I don't remember where we were.

FRENKEL: It'll come to you.

WU: Yeah. Anyhow we [shared] this big suite. And then once we arrived we turned on the TV and we saw the shooting with everything else. I was shocked; at that moment I was very scared […]. I pick[ed] up phone tried to call…couldn't [get] through.

FRENKEL: Did you try [to] call your mom?

WU: Yeah, yeah…my mom, of course.

FRENKEL: I thought maybe your brother because…how did you know he was there.

WU: Oh, no. Only later when my mother told me. [It] was worked [in] with […] what's going on in Beijing, because [the] news just said gunshots […]. So…a tank, right? So, I didn't really know how extensive the whole operation was, whether it actually affected…were my parents included or not. I was really scared, really scared, trying to call and couldn't get hold of anyone. Eventually, I got hold of my parents…

FRENKEL: How soon after?

WU: Oh, a day, a whole day actually. I couldn't. Either the phone was so busy…just everyone was trying to call. Everyone was calling […]. Then after my mother told me that my brother was there, and my mother was begging him not to go, and all that.

FRENKEL: What did he say as an eyewitness to you later?

WU: I don't think he was such…eventually he did listen to my mom. So, he wasn't there when the shooting happened, but he was there earlier camping out there earlier. At the time, he's already ready to come to the States, actually. There was September…no, June, June, 4 June, right? It happened [on] 4 June.

FRENKEL: I don't remember anymore.

WU: Yeah. Yeah, 4 June I think, yeah.

FRENKEL: But did he stay throughout the demonstration?

WU: He didn't wait to the end. He went home. He went home.

FRENKEL: He went home.

WU: He went home.

FRENKEL: To where?

WU: My family's home. My mother's home. Because we both went to school in Beijing.

FRENKEL: Do you think if you had been in Beijing…

WU: What would I do?

FRENKEL: Would you have been there? What would you have done?

WU: Oh. I'm not sure, because I was already in the medical school. Most of the students there are actually undergraduate students from Peking University or Tsinghua University. So, I mean these things usually happens in a crowd, right? You go with your colleagues and fellow students. So, I'm not sure how much the medical school was [involved] in that whole process.

FRENKEL: So, were most of the…

WU: My medical school was pretty passive. In general, they were pretty passive regarding the government situations.

FRENKEL: So, the students in Tiananmen were undergrads?

WU: Mostly undergrads I think, yeah. Mostly undergrads. A lot of humanities students.

FRENKEL: Sure. Political scientists and probably literature.

WU: Yeah, exactly, yeah. I think more than…so, if I were in Beijing, I'd have to say perhaps selfishly or knowing that what happened to my family, I probably…I would say I probably would have… maybe I'll go for curiosity or something…but chances are I'll try to stay away from it. I'm not proud of saying what I just said, but I mean I think the government has its…in a way I gave up. Yeah, I gave up about the whole communist government thing, right? It's not in my mind that I want to fight with…escape might be better route. To me, escape is a more…yeah. Yeah. It's just a personal choice. Yeah, I don't think I'm going to go fight with them. I mean actually a lot of scientists nowadays try to go back to China to actually reestablish the science there. If I go back now, actually there's so many opportunities. A lot of my friends are either in the process of going back or already went back. They're all becoming real leaders in China. They're like head of an institute or things like that. I'm just not interested in getting into those things, because in my mind, changing the whole bureaucracy system and everything else is not a struggle that I want to fight for. Yet, if I could help in other ways, I would. For example, I am teaching gradate students a course in Shanghai and Beijing. So, I go back every year to teach the students.

FRENKEL: What's the graduate course in?

WU: It's called Bio 2000. It's sort of an integrated graduate course. Yeah, but my involvement is only on the academic level.

FRENKEL: Okay. How soon after did Chinese students here get the invitation for amnesty? I forgot.

WU: Oh, you know what? Actually, when I was at Purdue, […] the 4 June, we went…I actually did…a bunch of Purdue students as well as students in the area went to Chicago [Illinois] for a demonstration for the 4 June event. I went there. I mean I wasn't the leader, but I did go. So, I think that's pretty much my role […]; if someone is organizing, I will follow because I do agree with whatever they're saying, but I'm not going to organize this kind of thing. This was, sort of, something that my parents instilled into us because…I guess, because [of] what happened to my family, we were always taught to stay away.

FRENKEL: Because of that two year[s] in the countryside?

WU: No, not just that; more happened. My father was considered bad for many, many years. To some extent he died [from depression], and a lot of it has a lot to do with his health.

FRENKEL: There were longer-term consequences you're saying.

WU: Yeah, definitely. […] Also, one of my uncles committed suicide in China.

FRENKEL: One of the three who were left in China, the younger…

WU: Right. So, the two girls and one boy, right, in the States, and then two boys and one girl in China. So, they're three and three. So yeah, he was also farmed out to a factory during the Cultural Revolution. Actually, he survived Cultural Revolution, but then after that he…I guess, he couldn't adjust very well or something. He wasn't happy […]; nobody really knows why he committed suicide. But it's all these things. And also, of course, my grandfather also wasn't treated very well. All these things led me to take the passive road.

FRENKEL: I can understand that when you have a history of such persecution you can decide to lie low.

WU: Lie low, exactly.

FRENKEL: I understand that very well.

WU: That's pretty much that. Yeah, my mother's always begging us to not do anything.

FRENKEL: Okay. [All right.] So when they offered amnesty, which happened, what, a year later or sooner? I don't remember anymore.

WU: It's probably a year. I would say at least a year later…yeah.

FRENKEL: You just immediately accepted it and…

WU: Sure, of course.

FRENKEL: You didn't have to do anything, really.

WU: Yeah, not much.

FRENKEL: What was it that you had to do?

WU: Show that you got here before the 4 June event. So, nothing, you really didn't need to do anything. I mean we just took advantage of it in a sense.

FRENKEL: Did you think through that that might be…

WU: We didn't want to go back. Actually, for many years I didn't go…actually, I came here in 1988. The first time I went back was the Year 2001. I think, the Year 2001.

FRENKEL: Did you think you might never return if you accepted amnesty?

WU: If I accepted it…never return? I was worried if I don't have a green card when I go back, I may not be able to come back. That I was worried. My parents came to visit me a few times, but I never went back, actually, until year 2001.

FRENKEL: They visited a few times before 2001?

WU: Yes, yes. Well, the first time…they came once when I was in graduate school, and then they came for the birth of my children, yeah.

FRENKEL: Oh, okay. Well, we're getting ahead.

WU: Yes, yes. They came to help me […].

FRENKEL: Oh, okay. So let's go back now, because I think…let me just check here. I think there might be one other follow-up question. Yeah, two other questions. We were talking about the lab and how catching the enthusiasm of Rossmann was. I would like to know what it was

like for you to be both a woman in this lab, how many other women were there, and also to be a woman who is foreign. How were you treated by the other graduate students and postdocs?

WU: In general, pretty well I think. Most of the labs are foreigners anyway. Most of the lab members were foreigners. Women…quite a few I think…quite a few woman as well, certainly more so than PIs. Because in my department, for example, we don't have a lot of women in my department.

FRENKEL: You mean there.

WU: Here.

FRENKEL: Now?

WU: […] Now, yeah. I think there are very few women who made it—if you will—to the higher positions; [who] actually took an independent position, [got] tenure and things like that. Fewer women have done that. A lot of them have tried to, [I think] … a lot of women are in graduate school. Even now I think we have more female students in our program than male students. The female students always do better…they just have better records. Their exams record's always better. They have better GREs. They have…

FRENKEL: But that's now.

WU: That's now. But even that, even…

FRENKEL: Even then in your lab there were more women?

WU: No, no, not more women…

FRENKEL: I mean at Rossmann's lab.

WU: Right. No, it's not more women, but [a] significant number of women that I didn't really feel that I'm unusual in that way.

FRENKEL: And the postdocs? How were they?

WU: The postdocs? In general, they're good. In general they're…

FRENKEL: Did anybody take you under their wing? Because Rossmann was away and I've heard that often a postdoc will mentor to someone who's an undergrad.

WU: Not exactly, not. Not exactly. Maybe I had one postdoc who taught me to do some of the things. But it's usually one postdoc taught me this, another postdoc taught me that. It's not like have one who will just teach me everything.

FRENKEL: Okay. So I guess your Ph.D. was the parvovirus work.

WU: Yes, yes, yes, yes.

FRENKEL: Okay. So at that point, you were very much committed to being a crystallographer.

WU: Yes, yes. I'm totally committed, yeah.

FRENKEL: During our break we were talking about the women who were pioneers in the earlier days of crystallography, and I wondered how much at that time you knew about those women.

WU: No. I actually don't.

FRENKEL: You didn't know.

WU: I really didn't. I learned a lot from that book, from Dorothy Hodgkin's biography.[2] I learned a lot from that.

[2] Georgina Ferry, *Dorothy Hodgkin: A Life* (London: Granta Books, 2000).

FRENKEL: That book, I should say, came out in 1998 in Great Britain, and in 2000 in the States, so this was a long while after you got your Ph.D..

WU: Yeah. But I think I did know a little bit. That's why I was interested in the book.

FRENKEL: You knew of her?

WU: Of her, and also Michael Rossmann is part of this historically because Michael Rossmann developed a lot of these methods as well.

FRENKEL: Because he was in Britain at the same time.

WU: He was. Actually, he solved the structure that gave Max Perutz the Nobel Prize. If you read Max Perutz's biography, there's a section there…if you just check Michael Rossmann and then you look for the section that he is involved in, he's the enthusiastic [postdoc] who went to [the] Perutz lab, made the first map of hemoglobin, and traced it, and discovered that hemoglobin really looks like myoglobin.[3]

Yeah, actually there was a little bit of a friction between Max and Michael Rossmann for that reason because Max was a little bit…I don't know. The book…Michael talked to me about it a little bit. They've always had a little bit of [discomfort], I guess, to some extent. There is a lot of psychology involved because Max had worked on it so many years and suddenly this young guy came and discovered this whole thing. Although it all belonged to him […] still he seems [to] feel that he wasn't the one who actually traced the molecule.

FRENKEL: I have heard that in Great Britain the system is a little bit different than here in terms of discovery and credits on research papers. I heard from one other person that they solved something and yet the PI was the first author, and the credit wasn't as readily acknowledged as some people feel their work has been here in the States.

WU: Yeah, I can understand that…

[3] Georgina Ferry, *Max Perutz and the Secret of Life* (Cold Spring Harbor, New York: Cold Spring Harbor Laboratory Press, 2007).

FRENKEL: So, in terms of your experience in the Rossmann lab and the papers that came out of there, it sounds like you were treated your well and your work was acknowledged.

WU: Yeah.

FRENKEL: There were no fights over authorship while you were there?

WU: There is.

FRENKEL: There were.

WU: There is one little incident. I was […] not happy with it. What happened was when I just joined the parvovirus project, I was actually working with a postdoc…no, is she a postdoc or student? She might be a senior student…yeah.

FRENKEL: She was at the time.

WU: She was, yeah. That's what I meant. And she was a…yeah. So, I joined here. I really worked with her very closely and I helped to solve the structure. So on the very first parvovirus structure that was a *Science* paper, I thought I probably should have been the second author on that paper.[4] I was actually one of the last. Michael pulled out the first author. Of course, it's her project, right? All the rest, actually, Michael did it alphabetically.

FRENKEL: That's how he solved the problem?

WU: That's how he solved the problem in that particular case. I thought that wasn't really fair. Now I don't really care that much, but at the time, I really did because that was my first paper in graduate school.

FRENKEL: That was the parvovirus?

[4] J. Tsao, M.S. Chapman, M. Agbandje, W. Keller, K. Smith, H. Wu, M. Luo, T.J. Smith, M.G. Rossmann, R.W. Compans, C.R. Parrish, "The structure of canine parvovirus and its functional implications," *Science* 251 (1991): 1456-64.

WU: That was the first parvovirus structure paper. Later I had two other first-author papers, but not in *Science*.[5] Not as a really big paper and the first…

FRENKEL: Oh, that paper that you were upset about was in *Science*?

WU: Was in *Science*, yeah. I was one of the…I was almost at the end because it's W. it's like he…he's the last author, the other person was the first author, and then you have everything else in between alphabetical.

FRENKEL: So, you were second to last because you're Wu.

WU: Yeah. Actually, I don't know if I'm second to last, but…

FRENKEL: But something close.

WU: Something close, yeah. And he didn't really make a note saying that everybody was alphabetical. There wasn't a note. Just that's how he explained it to me that this is alphabetical because so many had [been] involved in the project he felt. So, that's…in Michael's lab, yeah, there had been other dispute of authorships as well. I think it's hard. It's hard.

FRENKEL: But they didn't involve you at the time.

WU: [No…]; this was the only that involved me.

FRENKEL: But those other ones were happening while you were there.

WU: Yes. […]

FRENKEL: Did that create a strained atmosphere? Were you affect[ed] by the atmosphere because of that, or [did you just find] a way to ignore that?

[5] H. Wu, W. Keller, M.G. Rossmann, "Determination and refinement of the canine parvovirus empty capsid structure," *Acta Crystallography* D49 (1993): 572-579; H. Wu, M.G. Rossmann, "The canine parvovirus empty capsid structure," *Journal of Molecular Biology*, 233 (1993): 231-244.

WU: I try to ignore it […]. No, it didn't really affect [me]…but I was upset. I remember I was upset that…I guess we'll get there, but my ex [husband] was postdoc at the time.

FRENKEL: Your ex?

WU: My ex, yeah.

FRENKEL: You are divorced now.

WU: I'm divorced now, yeah. He was a postdoc in Michael Rossmann's lab, and that's where we met. In one case he also got upset because the structure that he solved, he didn't end up to be first author because another postdoc grew the crystal and Michael basically said the other person needs the paper—needs the paper more—so, the other person got to be the first and he end up to be the second.

FRENKEL: Oh. But the other guy had crystallized it?

WU: Crystallized it, and worked on it for more than I guess my ex did. [cell phone rings] But he couldn't solve it. It was after…oh, this is [about] my floor.

FRENKEL: Shall I pause it?

WU: If it's okay, yeah, thanks.

FRENKEL: I'll pause it.

WU: It's about my floor.

FRENKEL: We're back on after a short break, and Hao has just revealed that she met her then husband while in graduate school. So, maybe we can talk about meeting and marrying while still finishing your Ph.D., right?

WU: Right. We shared the same office. I guess it's proximity; part of it is proximity. He finished his Ph.D. [at] [University of California] Berkeley, and he was doing a postdoc with Michael Rossmann. Actually, he taught me a lot about programming because I was doing this computational project. Often times I was trying to debug something and I couldn't find any problem. He would just come and then he would find it like […] away. He's a very experienced programmer. So, that's the initial interactions I guess. I've always thought he's really, really smart and I was…

FRENKEL: Where was he from?

WU: China. He was Chinese, yes.

FRENKEL: Where in China was he from?

WU: Dalian.

FRENKEL: Where is that?

WU: Dalian. It's a – D-A-L -I-A-N. Dalian, yeah.

FRENKEL: And is that anywhere near where you grew up?

WU: No, not really. It's not too far but not…[…]. We liked each other.

FRENKEL: How soon after you met did you get married?

WU: Actually, it's complicated because he went to Purdue because his then girlfriend was in the neighboring lab. And then I had a boyfriend from my medical college […]. He [had] actually just moved to Purdue because of me. I know…it's complicated. Anyway, I can tell you what happened. And then when he arrived, I was already married I think. Yeah, I was already married.

FRENKEL: To the fellow who followed you from China.

WU: Yes. So, he was a graduate student there as well.

FRENKEL: When did you get married?

WU: My first marriage was 1989 I believe, summer of 1989 because…

FRENKEL: Oh, okay.

WU: [In] 1988 we came to the States together, but he was in a different place. And then he switched graduate school to Purdue because I was there. So, as soon as he arrived, we got married, [but] I was really naïve […] about relationship[s] and marriage, love, because I really didn't date in college, not really. I mean I probably had crushes here and there, but never really dated. It's partly the culture, partly it was just me being a geek or a nerd…spending time other ways.

FRENKEL: Oh, right. We actually didn't talk about how you were reading literature. You mentioned you wanted to say that you had…in medical school you didn't have time, but you did find time…

WU: In graduate school I didn't have time, but…

FRENKEL: Well, I guess I was including graduate school and medical school.

WU: Oh, okay.

FRENKEL: But during the break you were saying how you read all this literature.

WU: I read a lot of stuff, yeah.

FRENKEL: So, rather than socializing, you were reading literature, right?

WU: Yeah. Well, I was also socializing, but I didn't have single boyfriends and those kind[s] of things. I wasn't really a recluse or anything like that, but [I was] just doing other things. I have male friends but not boyfriends […].

FRENKEL: So, you were naïve and you got married right away.

WU: Yeah. Well he really wanted to get married. I was thinking, "Okay," [but] I wasn't really…I don't think I was so in love. […] He was my first boyfriend. Since he wanted it…but [that did not{?}] last, as you already know. But he's a nice guy; he's a very nice person. He's [Chenjian Li], [on the] faculty here now.

FRENKEL: [laughter] It's very complicated.

WU: It's like everything follows me. You don't have to mention that.

FRENKEL: Yeah, we could take that out if you [want].

WU: It doesn't matter. It doesn't matter.

FRENKEL: What I'm really interested in is […] did…well, [did you have children with him?]…

WU: No, no. With the second. No, I didn't have children in the first one. I didn't want to; also, [I was] too young. […] It was my second with the postdoc. […] I was very [much] in love with him, at least at the time I feel I was blissful. […] I had a huge crush on him […]; I just thought he is the smartest guy I've ever met, which is very rare for me, because I've always come out the other side. Usually the other guy think[s] that I'm the smartest girl that he's ever met. [laughter] Now the other way around. […]…[He, in fact,] married the girlfriend that he came to Purdue for; soon after he arrived, they got married also. Not my ex, right? […] Then eventually we both […] divorced the other person, [which] was quite scandalous as well. I guess people do forget. Well, I have to say it was quite a scandal at the time.

FRENKEL: Now was this scandal in the lab or a scandal amongst you who were Chinese in the lab?

WU: Both.

FRENKEL: A huge scandal. [laughter]

WU: I was embarrassed. Huge scandal. […There was a lot of talk] about whether we're being…what would be the word? I don't know. But it's a scandal. As you know, they're taking positions. They're making judgments.

FRENKEL: About who wanted to work with whom as well?

WU: No, just about the breakup. We broke up and then…just the particular event.

FRENKEL: The social…just the social aspect of it.

WU: The social aspect of it, yeah. But Michael was […] really, really nice to both of us. He was a postdoc with Michael, [and] I was a student with him. Before we went public, we went to talk to Michael, [so] Michael was the first one to know about us.

FRENKEL: That you were going to get divorced from your spouses, or that you were going to get married?

WU: Well, not getting married, just the fact that we're going to divorce our spouses and the fact that we are together now. We didn't get married then right away. Michael was very nice. He was very understanding. He was never involved in…he treated us the same way as before, so everything was good.

FRENKEL: Very professional.

WU: Extremely. Michael was amazing. He gave me…it's not here, the book. He gave me a [Henri] Matisse. He gave me an atlas of Matisse's work. And then he wrote something. He says…because he knows I was going through all these scandals, people talk about me and things like that. He wrote down something like…I can't repeat it. Something like that the ugly, and the evil, or whatever. Not evil. But if the ugly disappears, but the beauty and whatever persists. So, he was…he really didn't make any…he feels like this is how you feel, you should go for it […]. He was supportive of our personal decisions […].

FRENKEL: So, all this is going on while you're getting your Ph.D..

WU: Yeah. Also, I got it really quickly. I was one of the first to graduate from my class.

FRENKEL: So, when did you get your Ph.D.?

WU: 1992. So, it was a four-year Ph.D.. It was pretty short even for then […]. Now most Ph.D.s are six years.

FRENKEL: 1992, you said.

WU: 1992; I'm sorry. What did I say? 1992, yes.

FRENKEL: I don't know, but I was thinking 1982. But anyway…so, then you had to start thinking in term[s] of postdoc work and where to go, yet you were involved with the man who is now your ex. So, at what point did you marry and how did that figure in to where you were going to go?

WU: Right. So, he left first. He took a position at a company in Connecticut, Boehringer Ingelheim. It's a German company…Boehringer Ingelheim. He was the first crystallographer there, so he set up the lab there, so I already [knew] I [would have to] come to the East Coast around here.

FRENKEL: You weren't married yet.

WU: No, no, no. we're not married. No, no, no. Not married. But committed, I guess. Not really talked about…but we both know this is what we wanted. So, I only interviewed [at] Columbia [University] and Yale [University], the two places [that are] close by, [and] I […] decided to go to Columbia.

FRENKEL: How did you make that decision?

WU: […] Partly by exclusion. At the time, the [Thomas A.] Steitz laboratory, the other lab that [I] interviewed [at] was working on an enzyme called the reverse transcriptase, which is also a protein that my ex's company is working on as well. So, there was a little bit of a conflict of [interest].

FRENKEL: I see.

WU: And I also liked Wayne [A.] Hendrickson better. So, that wasn't a difficult decision. And then actually getting married was…even though I think I was totally in love and everything…the next thing that happened was unexpected: [I got] pregnant; I was pregnant first.

FRENKEL: You were pregnant upon arriving at Columbia?

WU: Yeah, [about] two months. Two months into it, I was already pregnant. The first thing [we did when] we got here was to buy a house together. He wanted to buy a house. […] Looking back, I [think] I really didn't want to buy a house together. Actually, a lot of my life [feels like] being pushed into something that I wasn't sure [about], like medical school. [The] same with buying the house, especially buying the house together, because that really says we're together, right? We bought a house together. That was also very quick. To me, that was a little too quick. But, again, it's the same thing. I really didn't have dating experience and I didn't really know.

FRENKEL: But you were pregnant.

WU: Yes, I was pregnant, yes. So, everything got pushed […] quickly. I was having children. I was only twenty-eight…well considering that I'm a scientist, you almost never have children when you were twenty-eight. I'm divorced four years now. […] Now I think I'm much clearer [about] who I am. I think I'm catching up with a lot of things that I should have discovered when I was much younger, in my twenties, about me…really about me, not about anything else, because I didn't…I don't know if it's just because I didn't date. Also, I didn't really live alone a lot.

FRENKEL: Oh, live alone a lot.

WU: Yeah […]. In college, it's always so many—six of us—live in the same…there was never the time or the space, I think, to discover about yourself. So, my ex and I basically…I mean

he's a really good scientist. He's actually a faculty [member] now at Columbia. We really didn't understand each other.

FRENKEL: Oh, he's now [on the] faculty at Columbia, but he also is at Cornell [Weill Medical College of Cornell University]? I thought you said…

WU: That was my first ex. I'm sorry.

FRENKEL: Oh, the first ex is now here.

WU: At Cornell.

FRENKEL: And the second ex is at Columbia.

WU: [laughter] You don't have to put these things down. This may be why I said this, I guess. Everything else can go. I mean just the personal life part of it I'm not sure. You're right.

FRENKEL: You can strike things from the transcript. You'll get a transcript and you will be able to review it.

WU: I mean I don't mind people know this. It's just I don't know if…you know.

FRENKEL: It's entirely up to you. I'm just going to try [to] get the narrative straight, and then you can do what you wish with it. But anyway, what's interesting is what you said that you didn't really have time…

WU: To learn myself.

FRENKEL: …in your twenties to find out about yourself.

WU: Absolutely, I think so

FRENKEL: Because you were immediately involved with men from one to the other and focusing on your career.

WU: Exactly, yeah, right. There wasn't a period that I just struggling with some boyfriend or something so that I learned about either myself or him and about relationships in general. There wasn't a period like that in my life when I was younger.

FRENKEL: Had you given a thought [to…]…if you had not become pregnant…had you at that time in your late twenties given any thought before that about when you might have children because of the need to balance your career with motherhood?

WU: Yeah, I did, I think.

FRENKEL: And what was your plan?

WU: The plan would be later than that for sure, [but] my second husband really wanted children, [I knew] and I think…well, I'm just analyzing it, I think he really wanted children then […].

FRENKEL: But it wasn't really discussed.

WU: It wasn't really discussed. And this is a typical Chinese man thing. [laughter] Oh, yeah. And I knew this was because he was saying that, "Oh, it's safe." We didn't use condom because it was right after my periods. He would just say—you don't need to write this, yeah. But anyway…I think, he really wanted me to get pregnant, but it wasn't discussed. And this was a common theme in my marriage.

FRENKEL: To not discuss major issues?

WU: Yes, yeah.

FRENKEL: Or how they might [have an] impact [on] your career.

WU: Right. My career was not in the equation, […] in his mind…things have changed, but slowly. But […] certainly at the beginning my career wasn't a big thing in his mind. To me that was perhaps one of the major reasons why I left him, although not consciously knowing also about the other things that we were incompatible with. I can give you some examples. When I was a postdoc…well my first *Nature* paper got accepted.[6] He wasn't happy for me. Because he was already independent at the time, right…I guess everybody goes through these struggles with journals, right. He said, "Oh, you get accepted to *Nature* only because you're working for Wayne Hendrickson," who is a big name in the field. Yeah, that was one example. And then when I was looking for a job, I wanted to find academic job. He said to me that it's not going to be practical for me to get an academic job because we have the children. At the time, we already had two […]. Wait, 1996 was my second, so I was probably already pregnant…yes, I was already pregnant with the second child. He feels that the best [thing] for us as a family to do was for me to take a position in this company [where] I was offered a position […] as well. But I didn't want it. [I] wanted to become a faculty [member]. I actually pushed him. He didn't drag me into his company, but I pushed him into looking for another job, and he was successful. I waited for him…I think I got this job in 1996, but I didn't start this job until 1997.

FRENKEL: Here, at Cornell.

WU: At Cornell. Because I was giving [him] time […] to look for a job in the city, and he got a job that was pretty unusual in the same field. It's not an easy thing. It wasn't easy. So, that should be such a blessing I think to the…it's falling off. That's going to fall.

FRENKEL: Hao was just adjusting her two photographs of her children.

WU: Oh. [laughter] Yeah.

FRENKEL: So, he did get a faculty position right after you got your faculty position.

WU: So, we started exactly at the same time. We started in July 1997. I here…he there.

FRENKEL: Where?

[6] H. Wu, P.D. Kwong, W.A. Hendrickson, "Dimeric association and segmental variability in the crystal structure of human CD4," *Nature* 387 (1997): 527-530.

WU: At Columbia.

FRENKEL: He's at Columbia now.

WU: He's at Columbia, yeah. He started in 1997.

FRENKEL: Okay. So, you did buy a house and I suppose it was in Connecticut because that would have been nearer his work?

WU: Oh, it's actually in Westchester [County]. So, he would commute to Connecticut. And I would commute to the…so, actually he felt he made the big sacrifice.

FRENKEL: Because there was a compromise that you both had to commute?

WU: Right. Actually, he has a longer commute than me at the time.

FRENKEL: He had?

WU: I think he has thirty-seven miles. I have seventeen mile[s], which is sort of in the middle. But time-wise it was probably very similar because I go into the city.

FRENKEL: Was it hard on you to commute being a postdoc at Columbia?

WU: That wasn't as hard as now. Now it's worse because it's more into the city, right? I was in the medical campus, so…

FRENKEL: But that's uptown so…

WU: Uptown, exactly. So, it wasn't as hard […].

FRENKEL: So, you have the house now and you commute from Westchester now.

WU: I still live in Westchester. We actually sold that house [and] bought another house in 1990…it doesn't matter. When my first child is ready for kindergarten we went to a better school district. Anyhow, when I left him…he kept the house. I just didn't want to fight. It's just something it's a recurring theme in my life; sometimes I feel I just want this to be amicable, so I left the house to him. He still owes me money.

FRENKEL: He owes you money now?

WU: Yeah, because the house and…I bought a condo in the neighborhood, so the kids go back and forth.

FRENKEL: So, you have joint custody.

WU: We have joint physical custody.

FRENKEL: How old are the children now?

WU: Eleven and fourteen.

FRENKEL: You have a boy and a girl?

WU: Two boys.

FRENKEL: Two boys? Okay. So now let's go back a little bit to being a postdoc.

WU: Okay, sorry.

FRENKEL: No, no, don't be sorry at all. This is all part of what it means to be a scientist, but also a woman who's a scientist, and the whole biological clock issue, and all that.

WU: Yeah, it's true. I mean I don't regret having kids earlier. Now I see the benefit of it. It's actually good that I had them early.

FRENKEL: Well you had them at twenty-eight and thirty-three.

WU: Thirty-one. They're three years apart.

FRENKEL: Right, thirty-one. So now let's talk about Wayne Hendrickson's lab and what kind of style he had as a PI.

WU: Completely hands-off.

FRENKEL: Okay. And how big was that lab?

WU: About the same I think. Probably about twenty people when I was there as well. Wayne is also a crystallography methodology person. He developed some [of the] best-used methods in crystallography. But he's one generation younger than Michael. He's in his sixties. Michael's in his seventies, close to eighty.

FRENKEL: Do they know each other?

WU: Oh, yes, of course.

FRENKEL: Where did Wayne get his training?

WU: Wayne got trained at [Johns] Hopkins [University]and the Naval Research lab […]. So, no, they didn't overlap in terms of training, but they hold a high regard to each other.

FRENKEL: So he was very hands-off.

WU: Very hands-off.

FRENKEL: So you were left really to […] come up with your own experimental projects?

WU: No, he give you projects. He tell you what to work on but the rest is yours until you have a structure. If you do have a structure, then he became a little bit more interested and he will look at the structure. He take the last.

FRENKEL: So, tell me about—in the most general, least scientific terms—your most significant work while you were in that lab. And when you knew and he knew that it was ready for that *Nature* paper and other papers.

WU: Right. Before I went to his lab, I wrote…he asked me to write a postdoctoral fellowship [proposal], and that was on the HIV [human immunodeficiency virus] binding molecule called CD4. That was supposed to be my major postdoctoral research project, and [it] was but I also took on a side project as soon as I got there.

FRENKEL: A sight project?

WU: A side. A side project as soon as I got there. This was a crystal structure of human chorionic gonadotropin. Do you know what that is? Or HCG [human chorionic gonadotropin].

FRENKEL: HCG. No.

WU: It's the protein that you're detecting in the pregnancy test.

FRENKEL: Oh.

WU: So, at the time…

FRENKEL: How apropos.

WU: It's really amazing because I was pregnant also at the time. And this molecule gets excreted [in] your urine. And the first crystals I had with these proteins were actually purified from me. I was actually collecting my own urine as part of the collection. It was interesting.

FRENKEL: This is hysterical.

WU: It was interesting. Yeah. Anyhow, so that was my first structure. But then my *Nature* paper was on CD4. So towards the end of my postdoctoral career I was able to solve the structure of CD4.

FRENKEL: Now people have talked to me about how hard it is financially to be a postdoc.

WU: Oh, yes.

FRENKEL: There's no money. You work insane hours. How did the hours that you kept at Purdue…what were they and how did they compare with what you needed to do?

WU: As a postdoc?

FRENKEL: To make all those achievements as a postdoc?

WU: As a postdoc? So, I think I worked insane hours as a graduate student because even though I was married, I didn't have children. So, there's no responsibility really. And my first husband is very flexible. He was very good in terms of that. […] But then after I become a postdoc, I become pregnant right away. I […] worked 9:00 a.m. to 5:00 p.m.. I had to, really. I worked 9:00 a.m. to 5:00 p.m., and I actually never […] went in for weekends…didn't go in for weekends. Of course, I'd work [at]home. Whatever I could do at home, I'd do at home. But I wasn't physically present in the lab on weekends.

FRENKEL: When you say you had to, why was that? Was that because the help left promptly at 5:00 p.m. or…

WU: Because I had to go pick up the kids.

FRENKEL: You had to pick up the kids from…

WU: Day care.

FRENKEL: Day care up in Westchester?

WU: Yes. We never had a nanny. See, that was also more […] his choice than my choice. I would [have wanted] a nanny. I couldn't get my way.

FRENKEL: And he was earning money probably at the pharmaceutical [company].

WU: No. after I become…oh, postdoc. Yeah, he was making certainly much more money than I do, yeah. And that would certainly help the whole family. He came from a family where money is a huge issue in the sense they always save. They only save, they don't spend. His parents are like that, very frugal people, to me to the extent it's not necessary.

FRENKEL: So, part of his frugality you're saying was to not have a nanny when you were doing your postdoc.

WU: Yeah. I really want to have someone who can…the thing is, he does help as well. It's not like he left everything to me.

FRENKEL: He did help out.

WU: He did help. But nonetheless, I'd always end up doing more[…]. He also always leaves…whenever he needs to leave, he leaves, even if he's in a meeting. He's very disciplined also. Time for him to go…he just go. That's just how [he operates], I guess. He's very strict with a lot of things, [and] that was hard for me. It was hard for me not able to work the hours that I want to work. But I did get a lot done. If you talk to people in Wayne's lab who overlapped with me, they'll tell you that at the time I'm probably the most efficient person they know. I just organize all my work in parallel or whatever and just try to get it done within that hour. Even after I became a faculty [member], it was still pretty much a 9:00 a.m. to 5:00 p.m..

FRENKEL: Okay. Is there anything more that you want to tell me about your time in that lab?

WU: Wayne's lab?

FRENKEL: Yeah.

WU: Right. Wayne was hands-off, right? But the time that I was there, there were lots of very good fellow postdocs, so that was very, very good. A lot of us became faculty.

FRENKEL: So, you had very capable colleagues to…

WU: To talk to.

FRENKEL: To exchange ideas with.

WU: To exchange ideas. Although I didn't take full advantage of it because I didn't have time to sit there and talk, really…9:00 to 5:00 and then I leave. So, I really didn't socialize.

FRENKEL: Was there a journal meeting every week, or presentations where you could talk with them?

WU: Yeah, right. But informally I really actually didn't…I didn't really have a lot of time to establish friendships, a little better friendship, I guess, with any of the postdocs there at the time. […] now I'm much better friends with a lot of those who I overlapped with and didn't have time to socialize. But now, I have actually more…any opportunity to actually socialize with them and get to know them more.

FRENKEL: Is that because you see them at conferences, or is there kind of an alumni gathering of Hendrickson's people?

WU: Yeah, sometimes it's that, and sometimes it's just because a lot of us stayed in New York, and we have meetings that [are] specific for New York. Every half a year we had this meeting together.

FRENKEL: Like the New York Academy has…

WU: Yeah, we have this thing called New York Structure Biology Discussion Group which actually I am organizing. I'm one of the organizers right now. We have two meetings every year. Free meetings. A lot of people come.

FRENKEL: Interesting. Is there a big crystallography community in New York? How many are there?

WU: So, the structure biology also include[s] other discipline[s]. But crystallography per se, we have two crystallographers here, SKI [Sloan-Kettering Institute]…actually Cornell, SKI, and Rockefeller [University] [are] probably considered one of the biggest [crystallography] centers anywhere you can see, […]. Sloan-Kettering I think have six crystallographers. Rockefeller has three at the moment, only because they lost two fairly recently I guess. One moved to [University of California] Berkeley, one became a CSO of a company [Structural Genomix].

FRENKEL: And Columbia and NYU [New York University].

WU: Oh, yeah, a lot of them.

FRENKEL: So, there are probably about fifty crystallographers in the city.

WU: Yeah, […at least].

FRENKEL: That's interesting.

WU: Yeah, a lot of us. And a lot of us came from Wayne's lab.

FRENKEL: Were there any setbacks in your scientific work when you were a postdoc? Anything that…

WU: Well, after my second child… no, not after my second child, before my second child I think. At some point I was thinking maybe I should just do a long postdoc and become a research scientist in Wayne's lab and just postponing becoming a PI for a few years. I did think about that.

FRENKEL: Why?

WU: Because it was just too busy with both ends, the work…

FRENKEL: The family.

WU: Yeah. I feel like maybe there's no way I could be able to do that. But then, I guess, I solved the structure of CD4 and then all the doors opened.

FRENKEL: Well, […] do you mean people were looking for you to join their labs?

WU: No, no, just job, job market. Then after I solved the structure of CD4, it become apparent that I should go look for a job.

FRENKEL: That it enabled you to…

WU: Yeah, right, exactly.

FRENKEL: So, where'd you look?

WU: Actually, I didn't look at a lot of places. I only looked at four places, I think. St. Jude [Children's Research Hospital]. I looked at St. Jude.

FRENKEL: You thought of leaving the city then, right?

WU: I was just looking anywhere just to…

FRENKEL: Just to get a feel of …

WU: Yeah. So, I interviewed at St. Jude, Burnham Institute [for Medical Research] at La Jolla [California], and then here, and Berkeley. So, I interviewed at four places. I got three offers. I didn't get an offer from Berkeley. So, it was pretty apparent that I probably would be here because my ex was in Connecticut. So, here at least we don't have to move […], even if he couldn't find a job in the city or something like that. But it was at the time that I suggested that maybe he should look, too. And that's why he looked.

FRENKEL: And he did look.

WU: He did look, yes. He tried to drag me to the company, but actually what eventually happened was I dragged him out of it.

FRENKEL: Oh, so that's when he got the appointment at Columbia.

WU: Yes, yeah. He really didn't think that we could do two faculty positions and with children.

FRENKEL: Why not?

WU: He feel like it's going to be too much. […] It is a lot of pressure. But to me, I feel like there got to be a way that we can both do what we want to do for our career at the same time do a good job with the family. I feel like it can be done especially if has been done my way, which would be getting the help that we need and be flexible and all those things, right? It didn't happen that way. I couldn't get him to get help.

FRENKEL: But when you say too much pressure as faculty, you don't mean financial pressure as much?

WU: Just work pressure.

FRENKEL: You mean the need to…

WU: To spend the time.

FRENKEL: …serve on committees, to publish all the time, to teach, and it's too demanding.

WU: Too demanding, yeah. He […] really didn't want me to look for an academic job.

FRENKEL: So, when you both became faculty members, which was in 1997, and he wouldn't allow help…

WU: Well, yeah. We never got a lot of help. We never had a nanny…the kids always go to day care. It's always day care.

FRENKEL: So, now you said you've been divorced for four years. So, this then went on from 1997 to 2004 or 2003.

WU: Yeah, so many years, […] a lot of years, […].

FRENKEL: So, this struggle…

WU: A lot of it was struggle, yeah. So, I think part of it was that. And another part of it has to do with raising the kids—our different philosophies of raising the kids. Because we came from very different family, different types of family. He grew up without…his family is very conservative in the sense they don't spend, they don't go anywhere, they don't try anything new, those […], things […]. And he's very focused in this research, and that's all he has. His interest is pretty limited to just the work. And he is a really good scientist. He's a very good scientist. But he's not interested in other things. So, with the kids, he also want the kids to […] grow up the way he grew up, because that's what he knows, right? What I know is very different. My parents have always exposed us to whatever is out there. And I try to get the kids to do a lot of things and he would always say no. Like ice-skating, for example. I want to take them ice-skating. I like ice-skating, so I want to take them ice skating, roller-blading, just little things…biking. He doesn't ride a bike. My ex doesn't ride a bike. He's not even interested in learning. It's very simple. He's very tall. He's 6 feet 2 inches or something. Riding a bike for him should be no problem. He has no interest. It's a very interesting personality. So, we had a lot of conflicts there. Piano, also. I mean eventually I won a lot of the battles, but it was just a struggle. I feel like I have to wage the battle all alone […].

FRENKEL: And yet with all these battles, you seem to have been able to establish your lab and run your lab. It's remarkable to me that you could, with all this going on, set up your lab and get all the scholarships and awards, so let's talk about when you arrived here what the package was and how you were recommended, because I understand you must be recommended for the Pew.

WU: Yes, yes, uh-huh.

FRENKEL: And with all this going on in your family, you must leave that for the background for the moment and come back to the enormous energy you poured into starting your own lab.

WU: Yeah. I think this also probably is in my upbringing that career is something that I never really…it's always been a priority. It's […] something that my parents instilled in us that this is one thing that you will never lose.

FRENKEL: Right. You said that. You said that.

WU: Yeah. It was very strong in my head, "This is something that you'll never lose." Anyhow, so I got a really good package here […]; the package was for four years they would support me with three personnel…yeah, three personnel for four years. But if I do get grant, they will reduce that support a little bit, but minimally; if [I] don't have any grants for four years, I could still have three people work in my lab. So, that was the deal. And then I can pretty much buy everything I need at the beginning. There's no budget. I bought everything I need.

FRENKEL: Wow, great.

WU: Yeah, I think eventually I spent…I'm not sure…if we include the x-ray machine I probably spent two million dollars. I'm not sure.

FRENKEL: Wow, just to set up?

WU: Oh, set up and the personnel for four years.

FRENKEL: Two million [dollars] for the four years.

WU: I'm not sure exactly how much because the machine itself is almost a million dollars. I probably only spent a million. Yeah, the package was good. I have to say the package was good. And my chair is very good, very supportive.

FRENKEL: Who was the chair at the time?

WU: He's still the chair, actually. Fred [Frederick R.] Maxfield. M-A-X-F-I-E-L-D.

FRENKEL: Okay.

WU: Yeah, very supportive.

FRENKEL: And then was he the one who suggested you apply for the Pew? I know you have to be recommended.

WU: There was an internal competition. I don't remember whether…because they announced us in the e-mail system. I don't remember whether I just saw it in the e-mail announcement. Oh, I think I had a collaborator who was a faculty [member] here who told me about the Pew. He's an old Pew [scholar named Jochen Buck, class of 1993]. He kept on telling me, "You should apply for this." Yeah, I think I vaguely remember that, yeah. […] I went through the pre-selection and then the selection. It wasn't something that I had to go through a lot of hurdles. It was just a proposal and then it just got selected.

FRENKEL: Can you talk about the importance at the time? I mean the Pew awards are… they're often used to supplement starting a lab. At the time that you applied, did you have an R01 yet?

WU: No, no.

FRENKEL: So, it helped you established this lab?

WU: Definitely, yeah, definitely, yeah.

FRENKEL: How important was it for you to get it?

WU: Oh, very important. Yeah, it was great. Actually, it was I would say one of the most memorable experiences. Yeah. Have you been to one of the Pew meetings?

FRENKEL: No. But I've been hearing about them. Tell me how it was for you?

WU: It was very interesting, especially when you went to a Pew meeting the first time, you just felt like you were part of the family. This is to a large extent owing to Ed [Edward H. O'Neil]…what's his last name, who's the director of the program. He is a funny guy. He basically would make jokes on especially all the new Pew scholars. It just make you feel like you're part of it or something like that. For example, I actually…I think I still have some of the things…

FRENKEL: Oh, stuffed animals?

WU: No, no. Those are from my students, by the way. [laughter] All those things were…all the things on the top are from my students. Oh, so what happened was the first year [at the Pew annual meeting] you always have to give a talk. So, I gave a talk. In Wayne's lab we have this tradition of opening up a bottle of champagne after you solve a structure. So, Wayne would do that. And then he would write the name of the structure on cork of the champagne bottle. So, in my talk, I think, I talked about several structures that I solved. And then I had the…

FRENKEL: You broke them.

WU: Yeah. I have a little champagne bottle as a background. So, they were making fun of me. At the last day we have this party…yeah, the last day we always have this party…

FRENKEL: At the Pew?

WU: At the Pew, yeah. So, they were making fun of me. They had a collection of corks that they were pouring on me at the party. Basically they hand out these, sort of, awards, kind of, thing. It's not really award.

FRENKEL: That's cute.

WU: Yeah. It was really cute. That's what I got. I still have those corks from the Pew.

FRENKEL: As a result of the money that you received from Pew and.

WU: The money and the social aspect of it, yeah, getting to know other scholars.

FRENKEL: Were there structures that you solved directly because of the project that you chose to work on?

WU: Oh, yeah. Of course, yes. My first R01, yeah.

FRENKEL: No, no. I thought the Pew and the…

WU: The Pew helped me to get my first R01.

FRENKEL: Oh, the Pew helped get the R01.

WU: Yes, yes, right.

FRENKEL: So let's talk about the first R01 then. Who taught you or how did you absorb the best way to do grant writing?

WU: So, what I did was I took somebody else's grant. I asked another Pew scholar actually, Nikola [P.] Pavletich [Pew Scholar class of 1994] who's across [at] Sloan Kettering.

FRENKEL: I know him. I interviewed him, yeah.

WU: Oh, you also did.

FRENKEL: The one from Bulgaria, right? Nikolov.

WU: Oh, Dimitar [B.] Nikolov [Pew Scholar class of 1999]. Right, right, right. I think it's probably one year before me, right.

FRENKEL: Yeah.

WU: Nikola Pavletich was a few years more before me.

FRENKEL: What was it Pav…

WU: Pavletich […] he's Greek.

FRENKEL: Okay. So, you took his grant.

WU: I took his grant and I sort of just followed his style.

FRENKEL: For an R01, yeah.

WU: For an R01, yeah. And I got this remarkable score in the second percentile out of my first grant. My chair was shocked.

FRENKEL: Two percentile, wow.

WU: Yeah. So, I was very lucky.

FRENKEL: What year was that?

WU: That must be…wait, 1997, 1998. Probably 1999, yeah. Wait, no maybe that was before my Pew then.

FRENKEL: We probably could…is it on your resume?

WU: Yeah, Pew, I think I started 2000, but then the money started in 2000.

FRENKEL: So, it was later. It was later.

WU: So, it was later than that, yeah. But the money was also…so, I actually got the four R01s in a row after that. So, I think I have one 1999 and then year 2000.

FRENKEL: 1999.

WU: 1999, 2000, and then probably 2002, and then 2004, I think.

FRENKEL: It can't be right. It can't be right because you're class of 2000 for Pew.

WU: Right.

FRENKEL: So, if the Pew helped you get the R01, then…

WU: It might be the second R01. It might be the second R01.

FRENKEL: It might be 2002, 2004, and 2006.

WU: Yeah. I don't remember now.

FRENKEL: The only reason why I ask is because I want to talk to you about the funding climate for science.

WU: Right now…at the time…

FRENKEL: At that time.

WU: At that time it was good, actually.

FRENKEL: After 2000 it was still good?

WU: It was good for me, actually, yeah.

FRENKEL: Oh, okay.

WU: Oh, actually, it only went bad probably the past three years when I'm up for renewal.

FRENKEL: Okay.

WU: because I think the budget was pretty good until really the past few years, right? The NIH [National Institutes of Health] budget, yeah.

FRENKEL: But you seem to have been hit later because…well it took a little while for the Bush administration cutbacks to be felt. But that's why it matters if it was 2002 that you got your first R01.

WU: I think it's 1999, actually.

FRENKEL: So, then it was before you got your Pew.

WU: Yeah, I guess my first R01 was before that. Let me see. Let me just my…I have a list of grants support thing. Yeah, I think it was 1999 first one, but it's October 1999. So, that was probably right before I got the Pew, right before the Pew started.

FRENKEL: That you would have had to apply in 1999, right?

WU: Yeah, exactly, and yeah. Yeah, and then my second grant is 2000. I got it in 2000. And then I got another grant in 2002. And then got another grant in 2003.

FRENKEL: Every year.

WU: Yeah. And then I didn't get another until 2007. I had two grants renewed in 2007, yeah.

FRENKEL: So, you had a little bit of a dry spell there from 2003 to 2007. That's four years, right?

WU: Without new grants, yeah. Without new grants. But my old grants were still active.

FRENKEL: They were still okay?

WU: They were still active.

FRENKEL: Was there a crunch or was there…

WU: There was a little crunch that I had to shrink my lab, which I did.

FRENKEL: You had to do what?

WU: Shrink my lab. I did shrink.

FRENKEL: By how much?

WU: On the top, I had thirteen people and I shrink it down to about eight, which is the current size of the lab.

FRENKEL: Okay. I'm just going to stop us for a second, okay?

WU: Yes.

FRENKEL: I'll just pause us. We're back on after a short break during which we discussed whether it's a good time to stop for the day. Tomorrow we've decided we're going to continue with the nature of writing grants today and the change in funds available through the NIH. So, thank you Hao for your time today.

WU: Thank you.

FRENKEL: Okay.

[END OF AUDIO FILE 1.2]

[END OF INTERVIEW]

INTERVIEWEE: **Hao Wu**

INTERVIEWER: **Karen Frenkel**

LOCATION: **New York, New York**

DATE: **31 January 2008**

FRENKEL: This is Karen Frenkel, and with me is Hao Wu, and this is the second day of our interview for the Pew Oral History's project on biomedical scholars. […] Yesterday we decided we would continue today talking about funding. We had left off with some discussion about the series of funds that you had received in the mid-2000s. I guess, the last one that you received in annual interviews was 2004, right? And then there was a gap.

WU: Right.

FRENKEL: So, I wanted to ask you about your perception of the impact of this administration [under President George W. Bush] on NIH funding in your field, the extent to which you think it's changed since you became a PI, and how you're coping with it.

WU: Yeah. It has changed a lot. I think at the beginning in 1997, the funding percentile was very good. It was around actually 20-plus percent at the time. So, for me everything went really well at the very beginning. All the grants that I submitted almost annually…one every year…has always received less than 10 percentile. It was all very good. And suddenly around 2003 […] maybe 2004…suddenly the percentile dropped. And then, I guess, there must be accumulated good grants that didn't get funded and then suddenly everything became a lot more competitive. Oh, I think in 2003, I started my service on one of the NIH study sections as well. Then I…

FRENKEL: Thank you. We're just having some tea here. When you said that the percentile suddenly dropped…did you mean in general or for your application?

WU: Oh, no, just in general. Just the…let's put this somewhere. Yeah…let me think. [Because I was] sitting on the study section I realized that there [were] a lot of good grants, [grants…] the reviewers all liked […]; [but] then we saw the same grant again in the next cycle, [so I realized…] that it [had not been] funded. And it's actually really tough for reviewers because you're doing the service and then you feel like everybody hates you. [laughter] So, I mean, definitely it's just the funding climate. It's very different…during the [William J.]

Clinton years everything was so great. I mean certainly there's a huge anti-Bush sentiment for sure, including myself.

FRENKEL: Amongst science…

WU: Amongst the scientists yeah, of course…yeah, for that reason.

FRENKEL: So, then there was this gap that you told me about.

WU: Yeah, for my personal [funding], right?

FRENKEL: For three years. And you had a crunch and you had to shrink your lab, right?

WU: I did shrink my lab, yeah.

FRENKEL: So, in those three years…did you apply within those three years or did you wait until the third round…

WU: I did apply. Actually, I did apply.

FRENKEL: Each year you applied and…

WU: Well, probably not every year. But I think in 2004, I wrote another new grant which runs through two revisions and didn't get funded. But I kind of understand that because in an average lab…I've already had four active R01s at a time. Getting a fifth one is a pretty difficult business, especially for a very young lab. So, I thought that was just partly that, right. Most people don't have so many grants. And then when I started…I mean, the real shock was when I started to renew my other grants that got funded in 1999 and 2000. I actually published a lot of good papers on those grants and I couldn't renew them. That was really a shock I have to say. People even questioned my productivity.

FRENKEL: The reviewers did?

WU: Yeah. Because they…well, sort of, like they [are] just counting the number of papers. I mean I had…for one grant I think I had two *Nature* papers, one *Cell* paper, one *Molecular Cell* paper [and] two *PNAS* papers […].[7] And they feel that's not extremely productive.

FRENKEL: In a one-year interval.

WU: No, no. That's the whole funding period—four years. Like four years, yeah.

FRENKEL: Wow.

WU: Yeah. That came as a shock to me. I don't know if they're just…

FRENKEL: How do you channel such shock? I mean what were strategies when that happened?

WU: Well, I think, when I write the rebuttal…some people when they write their rebuttal they will express the shock, which is something I never did. I've always been polite and tried to really look at the comments from the reviewer's perspective and see why they think this way and try to address that. I feel going on [the] offensive…it doesn't help. It has always been the character of my life. I've always been, sort of, trying to understand the opposing view and see if I could address that.

FRENKEL: Did you really feel that there was an opposing scientific view or was it that they were trying to recycle you to gain time?

[7] Y.C. Park, V. Burkitt, A.R. Villa, L. Tong, H. Wu, "Structural basis for self-association and receptor recognition of human TRAF2," *Nature* 398 (1999): 533-8; H. Ye, J.R. Arron, B. Lamothe, M. Cirilli, T. Kobayashi, N.K. Shevde, D. Segal, O.K. Dzievenu, M. Vologodskaia, M. Yim, K. Du, S. Singh, J.W. Pike, B.G. Darnay, Y. Choi, H. Wu, "Distinct molecular mechanism for initiating TRAF6 signaling," *Nature* 418 (2002): 443-7; H. Ye, Y.C. Park, M. Kreishman, E. Kieff, H. Wu, "The structural basis for the recognition of diverse receptor sequences by TRAF2," *Molecular Cell* 4 (1999): 321-330; H. Ye, H. Wu, "Thermodynamic characterization of the interaction between TRAF2 and tumor necrosis factor receptor peptides by isothermal titration calorimetry," *Proceedings of the National Academy of Sciences, USA* 97 (2000): 8961-6; C.Z. Ni, K. Welsh, E. Leo, C.K. Chiou, H. Wu, J.C. Reed, K.R. Ely, "Molecular basis for CD40 signaling mediated by TRAF3," *Proceedings of the National Academy of Sciences, USA* 97 (2000): 10395-9; H. Ye, M. Cirilli, H. Wu, "The use of construct variation and diffraction data analysis in the crystallization of the TRAF domain of human tumor necrosis factor receptor associated factor 6," *Acta Crystallographica. D. Structural Biology*, D58 (2002): 1886-1888.

WU: Yeah, I think maybe partly that and partly just the whole funding climate that…when I first submitted the renewal I still have three other grants that are active. Maybe there are really a lot of balancing act on the part of the reviewer as well.

FRENKEL: So, you're thinking it was what I suggested that it was not so much the science as that there wasn't enough money to go around.

WU: Right, exactly. So, the reviewer has to make a choice in their mind which [grant applications] they have to support. So, this went out two cycles with this particular grant. I eventually got it.

FRENKEL: So, your solution was to really be persistent.

WU: Be persistent, yeah. My chair actually told me…I was pretty shocked, but my chair told me, "This is probably…" he has gone through other funding crunches in his career. So, he told me "This [is] normal, so you should just keep doing it and wait for your turn…" so to speak.

FRENKEL: So, he said be patient. So, you want to me to pause?

WU: Let me just…one second.

FRENKEL: We're back on again. So, he said be patient, essentially?

WU: Yeah, said be patient. He was very supportive. The department actually provided some financial help to me as well. For example, usually I'm supposed to supply 70 percent of my salary.

FRENKEL: 7-0?

WU: 7-0, yeah. I think for one year in between, I think, they supplied 50 percent of my salary rather than 30 percent. Also, I shrink the lab…so, everything was fine. I also actually tried to get a lot of postdoctorate fellowships which I was…well, people in my lab were successful in doing that. So, that also helped. So, for me it was a crunch, but it wasn't so bad that I had to go down a lot more.

FRENKEL: How did you make the decision who to let go and who to keep?

WU: Well, a lot of it [is] just natural attrition; basically, I stopped hiring, and I also let go two of my technicians. So, right now I still don't have any technicians. I had two before at the same time. One wanted to become a criminal forensic scientist. […] So, she moved on and then another person I just had to let […] go. I found her another lab, so actually…

FRENKEL: Well, that's nice.

WU: Yeah. Everybody else…postdoctorates…they find jobs and then I'm just not hiring anyone.

FRENKEL: So, now you're at eight.

WU: Yeah.

FRENKEL: You're at that, your shrunken level.

WU: Right, the shrunken level, which I actually think might be good for me in the sense at least the style of my mentoring – I feel a smaller lab is actually more cost-effective for me. I have more time interacting with my postdocs and students. I'm more hands-on. I'm happier that way. I feel more in control [because] I'm involved. Actually, when the lab was thirteen, I actually feel quite lost. I feel that I could not keep track of what's going on and the lab wasn't as productive…in fact.

FRENKEL: Oh, interesting.

WU: Yeah. It wasn't as productive.

FRENKEL: In terms of papers or…

WU: In terms of papers and the results…yeah. Certainly per capita or whatever, yeah. It certainly wasn't as good. So, actually now I sort of settle into this small lab…what's the word? So, [I] settle into this…

FRENKEL: Environment.

WU: Environment. Into the small lab. If I could spend less time writing grants…but I spend more time actually doing the science. It's actually better for me in general. Everybody, I think, tried to find their optimal size and optimal style of running a lab.

FRENKEL: Well, I have one other question about funding before we go on to your style a little further. Some researchers have said that in order to get funding, they've had to provide preliminary data as if they had already done much of the work they were trying to get funding for.

WU: Yes, we have to do that, yes.

FRENKEL: You've played that game, too.

WU: Oh, yeah. We have to do that. This is actually more obvious in our field than any other field because every project is a gamble. If you don't get crystals, for example, that diffracts to the resolution that you want, you would never be able to solve the structure. You would not get any results. It's like a zero. Yeah, for the grant that I got eventually I solved everything that's in there.

FRENKEL: Yeah. So, you need to know in advance that you can get crystals.

WU: Yes. I need to show them that I have crystals and sometimes you have to show them the structure as well.

FRENKEL: So, the grants are piggybacking on one another, really.

WU: Yeah. I really don't like that, but it's very hard to change that.

FRENKEL: Do you have any suggestions about in an ideal world if you could change it, how you would change that?

WU: Yeah. So, there should be some more exploratory grants that's just the…so, crystallization, for example, of something…not solving a structure of something. Actually, my postdoctoral advisor had tried, I think. He actually had tried to influence NIH to get grants like that. But I don't think it's…

FRENKEL: Just to prove the structure?

WU: No, like get a smaller grant. Like an exploratory grant, so that you could actually work on it.

FRENKEL: Why do you think they are so against that?

WU: I think it's just competition. For example, in a reviewer's hand, if you get three grants, all three are important. But one of them already has the crystals and the other ones do not have crystals yet. Who would you give the money to? So many labs are doing crystallography. This may be true in all fields. The thing is all universities are expanding. Cornell will be expanding as well. They're raising a billion dollars to build a new building and recruiting new faculty. And I don't see how they could be supported by NIH, right? Just the population of scientists are increasing, but the budget is not.

FRENKEL: Wow.

WU: Yeah. I actually feel more sympathetic to the newcomers. At least we were more established. Even if you have a funding gap, the school would try to help you, and also you have gained a little bit of experience in getting money so that you can handle it a little better. But the young people…

FRENKEL: Yes, the new PIs.

WU: The new PIs, yeah.

FRENKEL: So, in your experience so far in work groups during this current administration, which I guess is the time at which you first started working in work groups…have you seen new researchers—to your knowledge—have to drop out and do something else like teach in a college without doing research or teach high school?

WU: It's coming…it's coming, yeah.

FRENKEL: Have you seen that, or you don't know?

WU: Actually, one of my former postdocs has not gotten his grant. He probably has to move on to something else; […] I don't know what he's going to do yet.

FRENKEL: And you expect more of that, because you said it is coming.

WU: Yeah. Everything lags a little bit, right? It's like a five-year lag at least. Although NIH only recently […] started to lower the funding percentile for new investigators.

FRENKEL: When did they start that?

WU: Probably in the past year, also, I think. So, for example, a colleague here got her grant funded with a twenty-seventh percentile which was very, very unusual.

FRENKEL: Twenty-seven percentile.

WU: Yeah. Because that's her last try basically. NIH decided to fund her anyway.

FRENKEL: Did you say the crystallography is expanding or is it that – I think you said yesterday a lot of labs are doing crystallography that are not really crystallography labs.

WU: Yes, right, right. That, too, yes.

FRENKEL: So, is crystallography itself also growing?

WU: Yes, also growing…

FRENKEL: In addition to other people doing.

WU: Absolutely, absolutely. Yeah, absolutely. Everywhere.

FRENKEL: That's tough.

WU: That's tough, yeah. Every discipline is expanding; I don't know how to even get support. Also NIH has shift[ed] a lot of the R01s. Well, if you talk to the NIH officers they would say they didn't shrink the R01 funding, but in general, they didn't really expand R01 funding, so that you get…they're shunting a lot of money to these big projects.

FRENKEL: Right. I mean, what I'm hearing is [that] the rate of acceleration is slowing. So, it's creeping up by maybe a few percents each year, whereas the costs are increasing by more. And then there are these super-big science projects.

WU: Exactly, which they want some legacy out of, which is totally a waste of money. I mean, okay, maybe that's an extreme.

FRENKEL: So, you think big science is not a good idea.

WU: I don't think it's a good idea. Certainly not…

FRENKEL: Why?

WU: Well, for example, one thing that I do know quite well is structure genomics, which they have been supporting for the past…probably almost ten years. All these structure genomic centers…they spent so much money in solving these structures that are really not so interesting. They probably helped to push the development of technology such as automated this and automated that. But those developments really could have been done with a lot less money and with a lot more benefit to the general community rather than just to the structure genomics community. Yeah, it's really not interesting.

FRENKEL: Tell me what you think are the really interesting structures to solve then?

WU: Well, those are the ones with very strong biological functions, right? And those are really only solved in individual labs with the interest of the individual PIs.

FRENKEL: You mean something that relates directly to something clinically.

WU: That as well as just large molecular complexes that the structure genomics project would not be able to support because they would require persistence, ingenuity, and a lot of thinking, and a lot of trial and error to actually pound these targets. The structure genomics is really…they have a million targets—it's not a million—but a million targets, for example. And then they just try to solve all of them. But they probably only get 2 percent success rate, but they pick the easy ones. Because they only try once, right? So, they just basically pick this low-hanging fruit. So, they solve quite a bit of structures, quite a number of structures. But they're not the most important nor the most difficult.

FRENKEL: Could you give me an example? Do you mind?

WU: Yeah, yeah. Let me try. So, there are a lot of structure genomic centers, right? And a lot of the structures that they solve are from thermophilic bacteria, for example. And oftentimes one particular structure would be solved by all five centers, the same structure because they have overlapping targets, and the ones that are easy got picked by all of them.

FRENKEL: Can't they communicate and say, "We are already doing that, so bug off"?

WU: No. It's very hard because everybody…well, a lot of centers say they want to solve proteins that have a clinical relevance, proteins of the eukaryotic origin, and things like that. But in essence, because those proteins are more difficult, they end up solving…their homologs, for example, in the thermophilic bacteria, in methanococcus, all these things. And they're tiny structures that you can't tell the function of […] anyway. A lot of crystallographers are opposing the structure genomics effort, but NIH is not really listening.

FRENKEL: And you do have this complex structural group that you've been looking at that was part of your Pew, right…

WU: Right, right, right.

FRENKEL: What was that? Refresh my memory of what is that called the…

WU: Signaling complexes.

FRENKEL: Yeah, signaling complex and the TRAF [tumor necrosis factor receptor associated factor]?

WU: TRAF.

FRENKEL: TRAF? Is that what it's called?

WU: Yeah, right.

FRENKEL: Now is that part of a big…

WU: Yes, they are […].

FRENKEL: So, that's your approach.

WU: Yeah, trying to…

FRENKEL: To look at the attraction of a bunch of proteins in a complex that affects the immune system.

WU: The immune system, exactly, yeah.

FRENKEL: Which as I understand has relevance to Alzheimer's disease and then in related work…cell death which is cancer, really.

WU: Cancer. Yeah, cancer and the immunology, autoimmune disease.

FRENKEL: Okay.

WU: Yeah, it's such a waste of money because these centers are just so rich and they just, sort of, waste the money on doing these things that are not so interesting.

FRENKEL: I know you don't want to point fingers, but, I mean, for example is the work of the Broad Institute falling into the category you're critical of?

WU: No, no, no.

FRENKEL: Well who are some of these big science project[s] that are redundant in the way you describe?

WU: These are structure genomic centers. For example, there's a Northeast [Structural] Genomics Consortium, and there's a New York Structure Genomics Consortium [New York SGX Research Center for Structural Genomics] . There are two in California. There's one near Chicago [Illinois], which is associated with the beam lines there.

FRENKEL: Associated with what?

WU: With one of the beam lines there, Argonne National Lab.

FRENKEL: Oh, oh, beam line is Argonne.

WU: Yeah […], one of the beam lines there.

FRENKEL: They have redundancies.

WU: They do, yeah, redundancy and not mostly interesting things to support.

FRENKEL: And so they don't get reviewed by the regular study groups, right?

WU: It's different. They have special review process. So, you do need to compete to get them, but…

FRENKEL: It's a different process.

WU: But it's a different pot of money. NIH is putting aside this money do to this.

FRENKEL: For these big science…

WU: Yeah, for these big science…yeah.

FRENKEL: Well, you can't have two big pots of money.

WU: You can't have both…yeah.

FRENKEL: I see. Okay. So, is there more that you would like to say about funding and funding strategies?

WU: Yeah, in general, I think NIH is really trying to shape what the investigators should do. They're directing too much…I feel like. They should just let investigators do what they want to do and support them just by the merit of the science rather than anything else. I mean, structure genomics is one, and they're also supporting a lot of clinical trials. Bio-defense, right, is another thing that came out in September 11th. I can't say I'm against it, but really, the best bio defense research would come from regular lab rather than these…

FRENKEL: Regular small labs?

WU: Yeah, instead of these directed research…yeah. They have all these separate pots for [this] money. I mean…[…], NIH [is] like anywhere else, they want to have some kind of legacy. They want to say, "Okay, we tackled cancer," like [President Richard M.] Nixon. "We tackled cancer, or we tackled bio-defense," those pathogens, or whatever.

FRENKEL: I see. That's interesting. Well, what about private money? Have you gone after foundation money?

WU: Yeah. A lot of the foundation money [is] supporting disease as well…most of the foundation money. We have a lot of the foundation money for the postdoctoral fellowships.

FRENKEL: This institution or your lab?

WU: No, no, my lab. I'm saying my lab, yeah. For example, we had quite a few fellowships from Cancer Research Institute, The American Heart Association, Damon Runyon [Cancer Research Foundation]—a postdoctoral fellowship foundation. I haven't really applied a lot of the foundation grants for the simple reason that they try to support more translational research, which I haven't really done.

FRENKEL: What's that?

WU: Well, it's like a translation to clinical applications…which is a direction I would like to go, actually. It's just everything takes a little time trying to see how my role can be in this process. It's something that I have to learn…that I want to learn as well. I think it would be nice to translate […]; it would be nice to see some of the research results get some clinical application. […]

FRENKEL: Okay. Now if you were the head of NIH today…

WU: Right. [laughter] Okay.

FRENKEL: Let's fantasize a little. What changes would you make to funding research, in a nutshell? I got the gist of some of it, but..

WU: Right. I would say reduce these targeted research and just let the researchers do what they feel right and then get the peers to review it.

FRENKEL: Let science run itself.

WU: Yeah, exactly […].

FRENKEL: Okay. Now let's move on to writing up results. When do you feel that a paper is really ready to be written?

WU: Right. Well in our case most of the time it's when you have a structure. And then from the structure you actually understand something, and for us that's when the paper's ready to be written. Most of the time…

FRENKEL: So, people have said to me, "When we have data and we feel that there's a story to be told." So, your data is solving the structure.

WU: Plus the analysis, yeah. Analysis of the structure and the follow-up work in cells, for example, to see [if] whatever you learned from the structure is actually relevant.

FRENKEL: So, the analysis of the structure. Can you just explain to me what that means?

WU: Yeah. For example, you see these two proteins interact in a certain way. You want to mutate interface and put the proteins back into the cell to see if that's really affecting the signaling process.

FRENKEL: Oh.

WU: Yeah, something like that. So, actually all our papers are […] like that. It's always a component of the structure and then a component of the biochemistry, and then a component of the cell biology that actually tells you that whatever you see is actually relevant to the physiological process.

FRENKEL: So, that's very clear-cut. Because sometimes I've heard that there's a kind of paper inflation out there and people rush to publish…

WU: Because of competition, right. But in general […] in those cases…well, it's a risk. It is a risk. If you wait, you have the chance of being beaten by another lab. However, if you don't

wait, you end up not publishing the most high-impact paper as you would like. So, it's […] a balance, because everything is very competitive. I guess competition is always good.

I'm trying to think whether it is good or bad to the field of science, because there is a lot of repetition, just naturally occurring repetition of the same work, right? But on the other hand, if you've both reached the same conclusion…in a way it's also a validation that everything was done correctly. So, I guess you really shouldn't run…if the scientist want[s] to do it this way, you shouldn't tell the other scientist, "Don't do this. I'm doing this," and divide the pie. That's like economy, right? You want them to compete. [laughter] That's how you get the best, right?

FRENKEL: Right. And yet, if you publish a lot of papers, like you did in that interval for the R01 that wasn't renewed, that's not necessarily good enough. So, the publish or perish…the competition to beat out another lab and publish doesn't always work either.

WU: What do you mean?

FRENKEL: In certain funding climates.

WU: Oh, yes, yes.

FRENKEL: Well, remember that time you said you had all these papers in a three or four-year interval and the grant didn't get renewed.

WU: Yeah. But your publication does correlate with how people perceive you, I think…yeah.

FRENKEL: So, it gets you the prestige or…

WU: It gets you the recognition in the field.

FRENKEL: Sorry. Correlate with recognition is a better word.

WU: Recognition, right; and that's a big part of being in science. You want to do good work, and you also want to be recognized, of course.

FRENKEL: Right.

WU: Yeah, right.

FRENKEL: Have you ever been scooped?

WU: Yes.

FRENKEL: Yeah?

WU: Oh, yeah. Most of the time, we win, actually. But there are cases where…for example, in one case we already had crystals, but another lab solved it before we did. I think that might be the only case in which we actually already had crystals and another lab published it before us. Then we had to scratch the project at such an advanced stage. But otherwise…there are actually a few recently…oh, actually, there are quite a few now that I'm thinking about it. But, okay, so the first case, I think, it was probably in 2003 or 2004. A structure of apoptosis-inducing factors, called AIF. Another lab solved it first and published it before we published it.[8] But then actually, we did additional…well we didn't publish because we were doing this follow-up work to understand how this thing works, so even after they published it, we were able to publish actually in the same journal because we had a lot of other data.

FRENKEL: Oh, so it was an expansion in a way?

WU: Right, of the original work. So, I wouldn't call that a scoop, right? So, one case was that. And [in] another case we were working on a structure of a complex and then the individual component got published. But we were able to publish. Again, we did more work [so] we were able to publish in fairly good journals as well, even though the components were published. And then another case which happened last year was almost the same structure. That was the same structure that they published […] as we were actually writing the paper, so we rushed out a paper, but we did get it published, again for the same reason that we did more.[9] But it wouldn't be as good [as it would have been if we had done] a little bit more…

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[8] M.J. Mate, M. Ortiz-Lombardia, B. Boitel, A. Haouz, D. Tello, S. A. Susin, J. Penninger, G. Kroemer, and P. M. Alzari, "The crystal structure of the mouse apoptosis-inducing factor AIF," *Nature Structural Biology,* 9 (2002): 442-6; H. Ye, C. Cande, N.C. Stephanou, S. Gurgusan, N. Larochette, E. Daugas, C. Garrido, G,. Kroemer, H. Wu, "DNA binding as a structural requirement for the apoptogenic action of AIF," *Nature Structural Biology*," 9 (2002): 680-4.

[9] S. C. Lin, J. Y. Chung, B. Lamothe, K. Rajashankar, M. Lu, Y. Lo, A. Y. Lam, B. G. Darnay, and H. Wu "Molecular basis for the unique deubiquitinating activing of the NF-KB inhibitor A20," *Journal of Molecular*

FRENKEL: And had been first.

WU: And had been first, right. Then we could have published in a better journal. I think most of the results we had…we got […] published.

FRENKEL: So, when you first found out about these other papers beating you to it […] because they were less extensive in their work…how did it make you feel?

WU: Yeah. Well, at this moment I have to say it doesn't stir as much emotion as it used to […] because I accept that this is part of life. Because if you're working on something that's interesting and hot…you have to be prepared that somebody else would publish before you […]. We just try to do good work. And I don't want to just rush out a paper if I feel it's not ready; I'd rather take the risk, basically.

FRENKEL: And that's after the fact. But at the time how did you feel?

WU: How do I feel? I would say, for example, I feel much stronger back in 2003 when the AIF story [happened] and I saw they published the results I was really upset. The more recent cases I just took it and [said], "Let's cut our loss and get it published as well. Let's try to get a paper out." You take the fact that you win some and you lose some.

FRENKEL: With the AIF one did you receive word through the grapevine or did you open up the journal and see it? Because sometimes people hear by word of mouth.

WU: I actually did know about it, yeah.

FRENKEL: You did know in advance a little bit.

WU: For that particular case, I did know.

Biology 376 (2008): 526-40; D. Kommander and D. Barford. "Structure of the A20 OTU domain and mechanistic insights into deubiquitination" *Biochemical Journal* 409 (2008): 77-85.

FRENKEL: How did you find out? I mean did a peer review person quietly tip you off? How does that work?

WU: Right. No, this case was […] complicated. Once we solved the structure, we contacted the person who identified this protein, and it turned out he was collaborating with another crystallographer who also solved the structure. So, at the time, I thought, "Oh, okay. It's okay. You can collaborate with both of us, but you could test our hypothesis…but our hypothesis is ours, and you can test this for us." Then we said we maybe could even submit the paper together. But they didn't want to wait for us. The other group didn't want to wait for us because they didn't actually do any of the…they didn't have a hypothesis so they didn't really check what was important. In that particular case…this protein is a, […]…during apoptosis, DNA gets degraded, and this protein plays a role in that. And what we recognized [was] that the protein has a lot of positive charge and the protein can actually directly bind to DNA and this direct binding to DNA is important for its function. So, that's what we thought and that what we asked the collaborator to test. That would take a little time…mutagenesis and all that.

FRENKEL: How long?

WU: Just a few months. They didn't want to wait for us because they feel like their paper would be weaker because they didn't really have those…they didn't want to wait for us. They got it published. They submitted it and published. But we had a choice at the time, whether [to] write it up and send it at the same time. But I felt like I should wait until we actually know how this thing works. So, we waited. It turned out our hypothesis was correct. So, that wasn't a huge loss, but it was upsetting to see that they just rush out a paper.

FRENKEL: Yeah. But I mean in a way it sounds like you wanted the bigger picture, and in the end perhaps, in the eyes of the community, you were—is it correct to say—more thorough?

WU: I would say so…yes. Certainly I would like to convey that idea.

FRENKEL: I mean, you took the longer, broader view maybe. Very hard to make these decisions, I guess.

WU: Yeah […]. But my general philosophy is to do […] good work. If we had to rush our paper, we would do it, but…

FRENKEL: Have you rushed out a paper in the end? Have you ever decided, "Okay, we're just going to rush it out?"

WU: Yeah. Well…only when I know through the grapevine that something is accepted, or getting published, or already published online.

FRENKEL: Since those three scoops?

WU: Oh, those are all the three. I think two happened last year.

FRENKEL: But, I mean, the decision to rush out a paper, is that a result of those three scoops, or it overlapped with those three scoops? What I'm trying to understand [is] if the lesson to rush something out happened after those three scoops.

WU: But I still don't rush a paper out if I don't know…if I haven't heard something discreet. But if I hear something discreet I will rush out a paper, yeah. If someone else I know solved the same structure, I will rush out a paper.

FRENKEL: Yes. But is that after those three experiences you related to me?

WU: Mm-hmm.

FRENKEL: Yeah.

WU: Yeah, yeah.

FRENKEL: Since then is what I'm asking.

WU: Right. No, but it's not like…I don't really rush. I still don't rush the paper, only on the particular project that I know someone else already has it.

FRENKEL: No, I understand. I understand that part. You see what I was asking…[is] that if as a result of these three experiences you know have become a little bit more prone to push something through or…

WU: No, not really. […] I mean, I still try to be thorough and only rush when I hear something discreet.

FRENKEL: Right. I understand.

WU: Right. I mean that has always been the case.

FRENKEL: Exactly.

WU: Yeah, it has always been the case.

FRENKEL: Okay. So, now I wanted to move onto another topic […] about your style as a PI and things you think you took from the other PIs who you worked for. So, maybe you could…you touched on the fact that now that you're a little smaller you have more time to keep control over and oversee what's going on. How would you describe your style and what gives you most pleasure as a PI in general?

WU: Yeah. Hands-on, actually. I think hands-on gives me the most pleasure because I feel like I'm contributing a little bit to the work. And that's what I enjoy doing as well, actually getting involved with the experimental process as well as the big directional sort of decisions. The details also excite me as well. If they have done a really nice gel—a nice band that looks beautiful—it just makes me happy, make[s] my day in a way. So, I like to be involved. Actually, in an ideal [world] if I [didn't] have to write grants, I [didn't] have to review other people's grants or other people's papers, or I [didn't] have to sit on this advisory committee…that advisory committee…if I [didn't] have any administrative work, I [would] like to be working on the bench, [to] mingle with the postdocs and student. I would like to do that.

FRENKEL: Do you have any bench time now?

WU: None, none.

FRENKEL: Do you miss it?

WU: I miss it, yeah. At the beginning, probably the first two years I really did most of the work myself. The first year I had me and a tech. We did a lot of work with just ourselves.

FRENKEL: What is it about bench work that gives you such joy?

WU: I don't know. It's just so close to the actual results. You see it. You have something in your mind. You say, "Oh, I'm going to try this and see if it works," and if it does, it really gives you […] pleasure. You feel like you know what's going on. See, this is interesting, because I told you earlier, right, when I was a student in Michael Rossmann's lab I was horrible at lab work. So, consciously when I went to Wayne Hendrickson's lab, I tried to improve my lab skills. The thing is, I don't know what happened. It was just suddenly I'd become very good. I don't know if it's just mentality; also, Wayne was so hands-off…I had to make every decision myself and do everything myself. I don't know if that's what helped or [if] it's just the mentality; […] "Okay, now I'm a postdoc. I can do this now," or something. And suddenly I was just…my hands were getting so much better.

FRENKEL: When they say good hands, is that the precision of pipetting or what does that mean in your field?

WU: Yeah, partly it's that because, for example, when your crystals…and that was one thing I was so scared of. When I was a graduate student, I dare not touch my crystal because I feel like if touch it, I'm going to destroy it. Suddenly when I had to do it, I feel like I probably can do. And then I suddenly was able to do it and became really good at it. If you ask people in the lab, they say that I had a golden hand because I go [on] synchrotron data collection trips with them and I…well, they always ask me to manipulate their crystals because they think I do a better job.

FRENKEL: You mean like taking a pincer and…

WU: Yeah.

FRENKEL: …taking it out of the tube?

WU: The tube…try to also transfer them into protectants…everything. I'm just more delicate with my process that I don't destroy the crystal. I take a better care with these things.

FRENKEL: And then you go and you bring them to a cyclotron. And where is…

WU: Synchrotron.

FRENKEL: Synchrotron. Is that in Chicago?

WU: Oh, there's several. There's quite a few. So, there's one in Brookhaven [New York]. Brookhaven National Lab is one at CHESS…Cornell High Energy Synchrotron Source.

FRENKEL: Where?

WU: At Cornell. Ithaca [New York], yeah, CHESS. And APS [Argonne Advanced Photon Source] which is Chicago, or near Chicago. APS Advanced Photon Source. There's also ones at the West Coast, but these are the three that we go to.

FRENKEL: And then you come back with the data which must be pretty exciting.

WU: Yes, absolutely, yes.

FRENKEL: And is it at that stage when you get that printout of the data or on disk I guess, and Flash probably even…that you input that into your software and you see it to visualize it?

WU: Right, right. Data [are] everything, really, yeah. Data [are] everything. I still pretty much go to every synchrotron trip with my students and postdocs. I feel like if I don't go I will lose…well, first of all, I'll lose that excitement and I feel like I could help as well, I guess. That makes me feel useful. So, that's all part of being hands-on. I don't know. Ten years down the road maybe I'll become hands-off. I don't know. But right now it's certainly something that I enjoy very much […].

FRENKEL: So, conversely what frustrates you most about being a PI?

WU: Sometimes it's just motivating people; sometimes […] the grant…sometimes if you think you did a good job and you didn't get selected or the grants didn't get funded; those kind[s] of, things. And the other aspect would be sometimes you get someone in the lab and you know he's not a bad person—nobody is—but you don't know how to motivate them. Somehow they don't have this impatientness that you have. They'll sit there, and think, and think, and think, and think, and not doing anything. That's really what frustrates me. I don't like that. And they know that as well. The people in my lab [know] that. If I talk to them, and we agree to do something […], and if they just sit there and not doing. I just hate that. I want them to at least try it. If it doesn't work, it's okay. Then let's move onto another strategy.

FRENKEL: You mean they dawdle over the experimental design instead of trying the experiment?

WU: Yeah…just sit there and then they don't do it.

FRENKEL: Because they want to perfect the design…

WU: Oh, yeah, sometimes it's that.

FRENKEL: What else are they thinking about? They're reading papers?

WU: Maybe they were reading papers. Yeah, sometimes maybe they were just trying to perfect the experimental design, [in my opinion] for no reason. […] A lot of crystallization [and protein expression is trial and error; you try something and you see…

FRENKEL: I see.

WU: And you go from there and see if it works. Yeah, I don't like for someone to sit there and [be] theorizing [about] this for a long time and not really trying it.

FRENKEL: What's your threshold? How long would you feel is too long?

WU: Depending on how busy I am. If I'm really busy, I don't have time to deal with it. They can be sitting there doing nothing for a long time.

FRENKEL: Like how long? Five weeks…months? When does it really start to bug you that they're…

WU: Only when I have the time to talk to them, that's when it bugs me because I realize they haven't done it.

FRENKEL: Have you had to fire someone because they were too slow to start the experiments?

WU: I never really fired someone. I have certainly suggested that they…I've never really fired anyone, but I've suggested that they go look for something else, and usually I wait for them to find something.

FRENKEL: A postdoc, or a…

WU: A postdoc.

FRENKEL: But not grad students?

WU: Students I've never let go. Students are more moldable.

FRENKEL: What do you wish you had known…what's the most important lesson you've learned managing the lab that you…

WU: I'm still learning. I feel like I'm still not an optimal organizer.

FRENKEL: No, no, no, but that you wish you had known when you first started?

WU: That I know now, you mean, right?

FRENKEL: Yeah.

WU: The most important lesson for me is the fact that I really like being hands-on and that I didn't need to write so many grants and to expand my lab. Actually, I feel like at least for the near future, I would like to keep it this way, limit the number of people in my lab.

FRENKEL: Less is more for you.

WU: Less is more for me, yeah. The thing is, I'm also…my style, in general, is a little bit…what would be the word? I tolerate a lot. The same with my kids, actually. I really don't force my kids to do things. For example, I'm…so, this means in order to get something done, it's not like I just I tell, "Okay, you do this. You do this, otherwise you're gone," or whatever. I'd never do that. Most people in my lab, we really get along well. I'm not someone who forces…I don't have this nature that I force people or something. I have to discuss with them. If they have a problem I ask them to tell me and then we can discuss it. So, in that sense…also, as I said, I have really not [had to] let go anyone, which means I really have to try to get the best out of whoever I have. And this is my goal to try to motivate whoever…if I have decided to hire this person, I try to get the best out of this person which means it'll take time out of me.

FRENKEL: And you're satisfied with that way, or do you wish you were another way?

WU: I wish I am a little bit more strict, but it's not my personality. I've already taken…you see, this is something I…it took me a while to accept myself to be someone like this because my ex…actually, I think partly why I was attracted to him was the fact that he is […] the other way. He is just…this is how he wants it and this will be this. He doesn't waver, not like me. I always…I'm a typical woman, I think, who try to please everyone. [laughter] But then it has both sides of it, the benefits and the…I mean, in general, if people know me for a while, most people like me, I think […]. And I really value that as well. So, it's part of me…that's why I also really like Bill Clinton […]. I think he has this thing that…he has this insecurity that he really wanted everyone to like him. [laughter] Do you agree?

FRENKEL: I think that he is a people-pleaser and I think it can get you into trouble.

WU: Yeah. No, I agree, but I can identify with that to some extent, because I am like that as well.

FRENKEL: Well, it's not as if there have been terrible consequences to you for that. I mean you've done quite well with your way.

WU: Yes. I'm actually pretty persistent if I want my way, but not in the way that I just say, "Do it this way. I don't want to explain it. Just do it this way." Like with the kids. My kids…he's actually very talented—for example with the piano—but I don't force him to practice. See, that's the thing. If I just force him to practice, things would have been so easy, and that's what his dad does.

FRENKEL: Now when we discussed your childhood, no one forced you.

WU: Exactly. I think that's why I don't force others. That's exactly why. My parents were like me as well. They don't force me. And my relatives…when we were kids, we joked with all our uncles and aunts. We don't feel like we are the kids we can't talk to the grownup.

FRENKEL: Although, you know what? On the other hand they did want you to go to medical school and you quit.

WU: Right. And I and quit eventually. Well, it's also partly because I didn't really know what I want when I went to medical school. My parents never forced me. That would just…they think it would be good to have. And I think, yes, it'd be nice to be a medical doctor. So, in a way it's not like they really forced [it] on me. It was just something that they wanted to happen. I didn't really have too much of a preference on way or another.

FRENKEL: Right. I see the difference. I see what you're saying.

WU: Yeah, yeah, yeah. Even with my divorces, my parents [have] always been supportive. They feel this is how you want it and this is…yeah, they don't say, "Oh, for the kids, you shouldn't be leaving him." They never do that.

FRENKEL: Would you say then since you were not forced and you studied science encyclopedias at a young age on your own and read literature on your own, that your ambition comes from within?

WU: Yes, absolutely.

FRENKEL: From within?

WU: Absolutely […]. And I feel that that's the only way; [in fact, that] is how I feel with people in my life as well. I feel that's the only way. You have to be self-motivated. And I try to encourage [self-motivation as much as] I can with the kids as well. I can't force them. I can't force anyone pretty much.

FRENKEL: What do you think the source is of your ambition?

WU: Yes, that's a good question. I think partly it comes from the fact that I feel like that I could do it, and the enjoyment that I get out of it. As well as my family history, I think. I feel, like, at least on my father's side…actually, also on my mother's side…I feel, like, my mother was able to do all these things on her own really totally out of self-motivation, and the fact that my grandfather was very successful, and I had all these uncles and aunts who were ambitious. Yeah, that part I think runs in the family. Somehow it's an implicit thing. Also when I was growing up, nobody really treated me as a girl. It was just as a person. Nobody has…nobody around me has treated me that I'm a little bit less than anybody else. My uncle—the uncle who committed suicide—always jokes to my brother. He always says, "Oh, your sister's better than you." [laughter] My brother, he's okay with it. Anyhow…

FRENKEL: Okay. That's a lot of things, so I'm trying to think of where [I should] jump off from there. Because you are so self-motivated I need to just pursue a little bit about how you train your graduate students who you say are more easily molded. I've been hearing that [there are] some difficulties lately getting science students—and I think even postdocs—to write science papers well.

WU: That is a problem, yeah.

FRENKEL: But you have a facility with language. It wasn't a problem for you, right?

WU: Yeah. For me […] it wasn't the most difficult thing, but for a lot people it is…yeah.

FRENKEL: So, have you encountered that amongst your lab personnel, and how have you helped trained them to work on papers?

WU: Right. I have to admit I'm not sure that I'm doing a really good job in that because a lot of times if they give me a really terrible job, I just change it. But the thing is—one way or another—at least for the postdocs that had left my lab, usually by the time they left…for

example, they would ask me to read the research proposal for their job, […] and I suddenly would realize they're writing so much better. I feel like I don't know where they learned it from. Maybe it was just somewhere even just through the changes that I've made to whatever they write, they do get benefits. And I also try to get as many papers as they deserve. A lot of crystallography labs they just write one big paper and then don't write any small papers. For me, actually, it doesn't make any difference. […] The small papers [don't] make too much of an impact in my career, but I try to write them with [my students]. [Papers have] a greater impact [on] their career[s] than on mine, but I try to do it that way so they can be helped.

FRENKEL: You edit them, would you say?

WU: I do, of course, yeah. Even for a paper that's not so important for me, I would write it…take the time and effort to help them write it.

FRENKEL: But they submit a complete draft [that include] the data and the description?

WU: Yeah, more or less…more or less, right. We work out the outlines and things like that. […] I corrected a lot of those papers,…and maybe […] because they had [practiced] many times, they somehow got…[better]. I'm not sure that I directly tell them, "This is how you should write it;" I guess they just learn from how I write it.

FRENKEL: Do you want to say more on that, or we're okay.

WU: No, that's fine.

FRENKEL: Okay. Now I guess we can move on to more general things. Oh, no, there's one other thing. There's one other thing which is maybe if you could just pick the percents of time that you spend in your various areas as a PI. How much of it right now is grants? How much of it is mentoring, writing papers, and all the various things that you do, administrative, for example? How does it divide up for you?

WU: Okay. I would say maybe 10 percent I'm teaching…

FRENKEL: Right, I left out teaching.

WU: Oh, yeah, teaching. And then 10 percent travel. [laughter]

FRENKEL: To give papers?

WU: Yeah.

FRENKEL: Twenty-percent travel to…

WU: Travel, including all kinds of committee meetings.

FRENKEL: Meetings and synchrotron.

WU: Yeah, synchrotron. If I add that, it may even be more. And then the remaining part I would say, 60 percent grants and papers…yeah, and probably also including sitting on other graduate students from committees …chores.

FRENKEL: Committee…Ph.D. committees?

WU: Ph.D. committees [and] other chores. So, which really left me…I would say, maybe only about 30 percent of my total time interacting with people in the lab. I really want to increase that percentage. Interacting with people in lab, really sit down thinking, think about the project, discussing the project with them. It's not sufficient. For me, this percentage is not sufficient. I'd like to increase that.

FRENKEL: Well, we have…I don't want to miss it. Let me see. We had 10 percent teaching, 20 percent, sort of, travel, and then 60 percent…so, right now it's…we only have 10 percent left.

WU: Oh, 60 percent of the remaining I was thinking.

FRENKEL: Oh, within the 60 percent you would like more [time] with the bench and experimental design?

WU: Right, exactly, exactly.

FRENKEL: Okay, sorry. I misunderstood. Within 60 percent it's now 30 percent for that and you want to make it more. Okay.

WU: Yeah, definitely.

FRENKEL: I get it. I understand. Anything further?

WU: Yeah, I would like to cut down my travel is what I want to do…as well as committees. I need to learn how to say no, as you said. Need to learn how to say no.

FRENKEL: Okay. Let's talk about your field in general and trends that you see happening. There is a broader question that I can ask that some people have answers and other feels is too broad, which is thoughts on biomedical science in general at this time and where you think it's going. Do you want to speak to that and then maybe narrow it down to your field?

WU: What do I think? I don't know if I'm that visionary. [laughter] Yeah, which way medical science is going.

FRENKEL: Biomedical.

WU: I think certainly you will see a lot more research-related therapies. Actually, that's what I would like to see. Even though my research is very basic…but I would like to see a lot more of the benefit to the human health. There are a lot of these genomic science in general nowadays…it's not my favorite. I think a really exciting area is neuroscience. I think in the next ten years you'll see a lot more understanding of how the brain works, which also would perhaps translate […] into psychology, personality, or the extreme of it…those kind of things. Those are just really interesting even though it may or may not lead to anything…which might…I think it might. The thing is I'm a little bit conflicted regarding…I think, the more we learn [the better we understand] what is […] called normal.

But then how would you…I mean, that could act to suppress a lot of personalities. I mean a lot of […] genius is a little bit not so normal, I guess. [But at least learning about it I think would be interesting. I don't know where it would go after that. In my field, definitely the thing[s] that we learned from these structures I think definitely will lead to more drugs. And a lot of these molecularly-targeted drugs will come from our field […], because we're the ones

who provide the structure information and provide the assay for getting a drug that's specific against a particular target.

That's […] what I think is happening already…that you're getting a lot more therapies that [are] […] specific…which is [happening in] every field I think. [For] every category of disease I think this molecularization […] is really the future because every disease is always a heterogeneous population. It's not like you only have cancer. You have different molecular diseases that you have to target […] differently, so that would…

FRENKEL: You mean like, for example, within cancer there are many different molecular targets?

WU: Yeah, they're all extremely different. Even just breast cancer [is] completely different in terms of what went wrong in there. In that sense then one really needs to characterize the particular disease on an individual basis. […] There [have] been a lot of talks on this individualized medication.

FRENKEL: Kind of customized medication?

WU: Customized, yeah. So, […] before they start treating you, they would identify the molecular basis of your disease and then go about treating [it], depending on exactly what you have.

FRENKEL: And do you think that that's going to get less and less expensive? I mean isn't that…it seems so sky high to me now in terms of…

WU: Yeah. I don't think it'll be so bad, because all these molecular techniques, they're not so expensive. They're not prohibitively expensive to do. Such as genome sequencing, nowadays you can probably do it with a few thousand dollars. You can sequence your genome. Just the technology, I think, can be advanced to such a degree where you could actually do it with reasonable cost. I like that. […]. Probably everybody does.

FRENKEL: I mean I wonder if that might be true. I know that you were working on some molecular structures that are related to Alzheimer's [Disease] and I'm wondering [if] just like cancer and breast cancer very slightly different molecular processes…

WU: I'm sure, yeah.

FRENKEL: …for Alzheimer's.

WU: I'm sure.

FRENKEL: You are sure.

WU: Oh, I'm pretty sure about that, yeah. I mean neurons can die. They could die out of a lot of different reasons.

FRENKEL: Okay. I think maybe this is a good moment to talk about your hopes and dreams…

WU: My hopes and dreams…yes.

FRENKEL: …as a scientist.

WU: Yeah. It's very [much] related to what I just said at the end; I would like to contribute to that.

FRENKEL: This more customization and clinical…

WU: Yeah. My role would be trying to get or help to get the inhibitors of different molecular complexes, and hopefully this pipeline can get piped into clinical trials, and finding out exactly in what situation these inhibitors are useful…things like that.

FRENKEL: How close or far off do you think anything that you're working on is from clinical trials?

WU: All the proteins that I work on…I'm not really involved with any of the companies. But one of the protein that I worked on is in clinical trial…has to do with our result.

FRENKEL: Which one?

WU: Well, this is the XIAP, X-linked Inhibitor of Apoptosis. XIAP. It's in clinical trial. Well, a collection of scientists contributed to this, but we're part of it as well.

FRENKEL: At pharmaceutical company or here?

WU: Yeah, at pharmaceutical. No, not here. I'm not really doing any of those work, but part of our work formed the basis of the whole…

FRENKEL: When do you think that will be ready?

WU: It's in Phase 1 [clinical trials] at Genentech. And then I also know several other companies are trying to push that into clinical trials well. I think something will happen there within the next few years.

FRENKEL: And how does that work for you as the one who discovered the…

WU: I didn't patent…so, there's no patent or anything on my…it's partly just because I am…I wasn't very conscious of their application or of the intent of making that particular contribution a few years ago. This is sort of a [somewhat] newer direction in the lab. At the beginning, I was really […] focusing on just getting the structure, publish[ing] the paper, [but] then after a little while that [became] a little […] less satisfactory. You want to push something else out of it. That'll be something that I will become more conscious about.

FRENKEL: Now the XIAP work…was that an R01 based project?

WU: Oh, yeah it is.

FRENKEL: Or was it a…

WU: Well, no, both…both.

FRENKEL: Was it Pew?

WU: Pew as well.

FRENKEL: It did come out of Pew.

WU: As well, yes.

FRENKEL: Okay. I'm sorry. I couldn't quite remember where in the continuum it was.

WU: Actually, the Pew project that I proposed was very broad. So, it actually covers several of my R01s […].

FRENKEL: Okay. Any other patents since…

WU: I have a patent on the Alzheimer's Disease thing together with Columbia.

FRENKEL: Oh, what's happening with that?

WU: No therapeutics yet.

FRENKEL: Nothing yet?

WU: Yeah, nothing yet.

FRENKEL: Any clinical trials?

WU: No, no.

FRENKEL: Not yet.

WU: Not yet […].

FRENKEL: Do you consult for companies?

WU: Once in a while, yeah. In one case, probably years ago…I think in 2002 or 2003 one company licensed one of our structures. I didn't patent that, but they licensed it before we published it.[10] They want[ed] to identify inhibitor to TRAF6…which we [did] […] in our paper [that] we published…We […] have the inhibitor in the TRAF6 paper, which was […] *Nature* 2002, I think. And I had some associations with companies on XIAP, just […to] give talks […] about it…but not on [a] very involved […] level. I wasn't interested for a long time because I have to…well, to some extent, just the prioritization, whether I spend my time doing that kind of thing or […] I spend my time just do[ing] the basic research, because those are still the bread and butter of my lab.

FRENKEL: Does Cornell Weill have any regulations regarding consulting and owning stock in companies, pharmaceutical companies.

WU: You have to disclose [connections]; that's all, I think. And, of course, if you patent […] or license your thing, they take more than half of the licensing income.

FRENKEL: I see.

WU: Right. […] XIAP was one aspect. TRAF6 was another aspect [with which] we helped companies;…we also helped another company to get TRAF6 antibodies because we have the pure material, but, in general, I think my involvement with companies is not huge.

FRENKEL: Okay. Would you like to take a little break now?

WU: Yes, let's do that.

FRENKEL: Okay.

[10] H. Ye, J. R. Arron, B. Lamothe, M. Cirilli, T. Kobayashi, N. K. Shevde, D. Segal, O. K. Dzivenu, M. Vologodskaia, M. Yim, K. Du, S. Singh, J. W. Pike, B. G. Darnay, Y. Choi and H. Wu, *Nature* 418 (2002): 443-7.

WU: Okay.

FRENKEL: We're going to stop for a break.

FRENKEL: No, I'm just going turn this off.

[END OF AUDIO FILE, 2.1]

FRENKEL: This is Karen Frenkel, and this is the second half of our final interview for the Pew Oral History Project. And I'm with biomedical scholar, Hao Wu. Actually, we decided to talk a little bit about two things that happened during our breaks yesterday. When we took our first break, Hao went off to see some people working for her in another area of the building, or even another building where they're working on some computer equipment or software that you use. Is that right?

WU: Yeah. Well, it's actually we got new computers. They want to consult with me where to put them and how to arrange everything. Actually, we already decided what to do and then suddenly somebody else had input and they changed it. There was dispute of some sort and they wanted me to go settle it.

FRENKEL: Okay. And that led me to the question we have about the…a the remark yesterday that you made about software and because there is such sophisticated computer graphics software into which one puts structural data that the software enables people who are not as expert in the science to go ahead with the use of the software. And so, that leads in to the question we have about the impact of technology on your field. Maybe you can talk about software, if I didn't say it clearly or the right way…its impact and any other equipment that has enabled you to do your research that you could not have done as efficiently or at all in the past.

WU: Right. I mean, in general just how fast they can do [things] nowadays has completely revolutionized crystallography. Actually if you read Dorothy Hodgkin's or Max Perutz's biography, at the time they were really…computation is one of the biggest problems. They just couldn't calculate the…they couldn't handle [data] from a protein crystal. They're just way too much.

FRENKEL: Computation.

WU: Computationally, yeah. Computationally, they couldn't handle it. So, I would say that would be one thing that had the biggest impact in the field. Another one that I guess that's associated with computation is the fact that we have much better software now for automation in crystallography calculations. So, to some extent [this] software act[s] as a black box. You feed something in…something will spit out at the other end. If you're lucky you actually get something really nice at the other end. And this enables a lot of people to use crystallography, not only crystallographers, but a lot of biologists. So, I think the impact is huge. Crystallography, per se, was a field that required a lot of expertise. Nowadays it's become a method that you apply to a particular field that you're interested in to answer the biological questions.

Yeah…so, I think that it's a really great achievement. And the thing that's associated with the software is also crystallography methodology that has been developed by these frontier crystallographers including Michael Rossmann and Wayne Hendrickson, my Ph.D. and postdoctoral advisors. I would say in particular my postdoctoral advisor, Wayne Hendrickson, who really developed this method called multi-wavelength anomalous diffraction which make[s] the structure determination…changes structure determination from a trial and error process to a rational process because in his method basically you can produce the protein in a heavy atom-bound form, and now you just use that to derive phases or the structure directly.

FRENKEL: I'm sorry, to…

WU: Derive Phases.

FRENKEL: Phases?

WU: Phases, yeah.

FRENKEL: Phases of the molecule?

WU: Yeah. Crystallography is a diffraction method, and for every diffracting wave you have an amplitude and you have a phase.

FRENKEL: Oh, phase.

WU: Phase, yes.

FRENKEL: Okay. I misheard.

WU: Yeah, phase. You need both the amplitude and the phase in order to recombine the waves to generate the picture. The amplitude…you can measure […] because they become intensities as they hit any recording device. Amplitude you can measure. But you cannot measure the phase. The phase has to be determined from some kind of heavy atom thing; […] you need heavy atom in your crystal in order to derive the phases. And Wayne Hendrickson is the one who made that possible.

FRENKEL: How long ago was that?

WU: Oh, I would say just the past fifteen [years] or so…[…]. It's recent […].

FRENKEL: So, not long before you arrived there, right?

WU: Yeah. It's actually concurrent with the time I was there.

FRENKEL: Oh, very exciting.

WU: Yeah, that he developed this method.

FRENKEL: So, then were you one of the first to use it?

WU: Yes, absolutely . […] The software I worked on in his lab has to do with this method as well.

FRENKEL: Did you help program that software?

WU: Yeah, I programmed something together with him.

FRENKEL: And so now that software; is that open-source that everyone in the science community uses?

WU: Right, right. Since then people have rewritten those programs so that [they] become really easy to use. There's several program suites that everybody uses…like standards now.

FRENKEL: Are they commercial or are they just sort of passed around.

WU: […] Academic users in general […] get it free, but […] company users […] have to pay a fee. And the develop…I would say it's support[ed] by…sometimes […] by NIH, [and] other times […] just by national labs on software [that] was written by the scientists at Los Alamos [National Laboratory].

FRENKEL: What other kinds of equipment now? I guess you would call that hardware.

WU: Synchrotron. The other thing is synchrotron.

FRENKEL: Is it a synchrotron?

WU: Synchrotron, so…

FRENKEL: Synchrotron?

WU: Let me write it. You want me to write it? Here, I'll write it.

FRENKEL: S-Y-N?

WU: S-Y-N-chrotron.

FRENKEL: Oh, like synchronize. Synchrotron.

WU: Yeah.

FRENKEL: Okay. And has that become more refined over the last twenty years? When was it first…

WU: Yeah, last ten years…about the last ten years.

FRENKEL: The first synchrotrons were developed twenty years ago?

WU: Yeah […]. So, why synchrotron's so important. Synchrotron give you X-rays that you can tune the wavelength. You can get any wavelength you want. And also, of course, it's much stronger than what you could generate using a home X-ray source. So in the traditional home X-ray source…which actually was developed at MRC in Max Perutz's lab there as well…was a rotating metal, basically. A rotating metal. And then you use ionized radiation to hit the metal so that X-rays [were] generated off the target. But the only thing is you can only generate X-rays of specific wavelength that matches the [property] of the metal. It's usually copper.

FRENKEL: Wavelength.

WU: So, it's usually copper and the wavelength would be 1.5 Ångstrom. But on a synchrotron, you could tune any wavelength you want. Only combined with this, you could [use] the method that Wayne developed. You have to have specific wavelength for different experiments.

FRENKEL: I see.

WU: I would say the computer, the method, and then the synchrotron are the three most important breakthroughs in this field.

FRENKEL: And I know we talked about the special things that you needed to get when you got your package. And there was an X-ray machine of some kind, right?

WU: Oh, absolutely, yes.

FRENKEL: But it was a home one.

WU: Right, right.

FRENKEL: And it itself cost a million or around a million.

WU: Yeah, five or six hundred thousand dollars.

FRENKEL: About five or six hundred thousand dollars.

WU: Yeah. But we have two. It's not cheap.

FRENKEL: So, that would be for preliminary work on crystals?

WU: Yeah, right, only preliminary work, right. And Synchrotrons are all supported by either the government or NIH or DOE [Department of Energy], these big government agencies. They're free. They're free to all of us for use.

FRENKEL: Everyone in the building shares them.

WU: It's like a national resource. No, no, synchrotron…

FRENKEL: Oh, the labs, yeah. Because they're in the national labs mainly, right?

WU: Yeah, right in national labs, exactly.

FRENKEL: Right. Okay. Now the other reason for the break today and yesterday is that Hao has bought an apartment near her office because she has such demands on her time at work, and also with her children, [who] are up in Westchester. So, she was checking on some construction that's being done. I thought that we could then talk about the way that…we did talk about how you have joint custody [of] your children, and it was in the context of the divorce. But in terms of your typical day being a working mom, let's talk about that and the reason for the apartment.

WU: Right. Normally I spend at least two hours a day on the road which I…I would say that could be one of the causes of the divorce as well; […] I really wanted to move to the city because my ex also works in the city, right? He doesn't like the city, so he refuses to move. I guess I was frustrated. By the end of it, I [didn't] really argue anymore; I just pack[ed] and left. I really wanted to move to the city. It would be so much easier for me. Anyway, so my time…a normal day would be if I have the kids, I get up around 6:30 a.m. to 7:00 a.m. and I get myself ready, and then I pack their lunch. Most of the time my kids are really good. They'll feed themselves most of the times. Sometimes they will ask maybe, "Mom, can you make me an egg?" But other times they have Pop-tarts or pre-made waffles. So they in general are very good. So usually just get up and make breakfast. And then after I send them off, I go to work, which take[s] me an hour […]; so usually 8:30 a.m., by 9:30 a.m., hopefully, I get in. And then I start counting my time, number of hours in the lab, but by about 4:00 p.m. I have to leave. So, I […]… I don't have any lunch breaks. Really just try to pack my day.

FRENKEL: And you have to leave by 4:00 p.m. because they're done with school?

WU: They're done with school.

FRENKEL: And they have…

WU: But they do…they go to the after-school program, but then I still have to pick them up by about 6:00 p.m.. Just counting the traffic, sometimes it's very unpredictable. So, usually I leave at 4:00 p.m.. If I can't leave at 4:00 p.m., I leave at 4:30 p.m.. But it's never later than 5:00 p.m. because there's no way I'd get there on time.

FRENKEL: And you have them three days a week?

WU: Yeah. Well, it depends. So, the schedule is…wait…two, five, two, five two, I guess. The weeks are divided so that I have them Mondays and Tuesdays, and […] my ex [has] them Wednesdays and Thursdays, and then we alternate the Friday, Saturday, Sunday weekends. But it seems I also travel, so the schedule is pretty hectic. So, on the calendar we constantly change which day we have the kids. But I guess so far, everything's been flexible. My ex [is] pretty cooperating in that because he also travels, so we both help each other in that regard. A normal day when I get home. Just the chores, normal chores, talk to the kids, make dinner, try to spend some time with them as well. But, […] with work, I bring of lot of work […] home […]. Whenever if have a break…if the kids are playing with themselves or if they're doing something else I probably would take that time to do some work. You end up [being] very flexible. You take whatever you get and you work. Same is for weekends. I always bring a lot of things

home to work [on]. Of course, always my computer. Sometimes I also…if I have the kids, sometimes I don't come in. Sometimes I just work from home.

FRENKEL: So, it's kind of flexible here…somewhat flexible.

WU: Oh, it's very flexible, yeah. If I have to do a lot of writing, I just do it at home.

FRENKEL: Are there any accommodations here for women who have children?

WU: Accommodations? In terms…like day care?

FRENKEL: Yeah.

WU: I don't think so. There's no day care, but there is a day care at Rockefeller. I think most parents send their kids to the Rockefeller Day care.

FRENKEL: For the record, Rockefeller University is next door. Do you think there should be an alternate system developed for women who want children and families where day care is provided by…

WU: That would be nice, yeah.

FRENKEL: …institution or the government or something?

WU: That was talked about; […] a couple of years ago, we were discussing what we should do regarding the so-called the Strategic Plan 3, the new hiring and the new building. That should start I think in a few years.

FRENKEL: You mean Cornell was talking…

WU: Cornell's around probably 2010. So, one of the things that was brought up was whether we should actually get a day care or something equivalent for faculty and also whether they

should actually provide housing assistance, because for families usually faculty housing is not sufficient?

FRENKEL: What's happ[en]ing […] with that?

WU: I think proposals were sent to the top, so [I'm] not sure what's happening at the moment, whether things will be adopted or not.

FRENKEL: So, faculty are lobbying? Is it the faculty you sent the proposal…

WU: Yeah. So, actually it was the Dean [who] asked a number of faculties to participate in this discussion. I was in there. I was part of it. I think the committee had […] probably ten people […]. We had written a couple [of] recommendations to the school. It would be great. I think it's really hard. Actually, if you look at attrition rate between graduate school and the number of women faculty, there's a huge attrition between [the number of] students to PI. A lot of men survived, but a lot of women end up not having their own labs […] because [of] the overlap of child bearing [with] job and marriage and everything else. I mean, I can't say I did a good job because my marriage really didn't work…

FRENKEL: Yes, but…

WU: But yeah. I think I had my reasons.

FRENKEL: Well, I was going to ask you a related question about that anyway, so I'll move to that question. Because you did mention that…not to bring up something painful, but you did mention on your own that your husband wasn't very happy for you when you had your first *Nature* paper, and attributed some of the reason for that to your PI. So, he wasn't really supportive in a way.

WU: Yeah. I mean, he's supportive in other ways, because he's a good person to talk to because he is in my field, so I could talk to him, but in general, I think he didn't really understand. It's partly just poor communication, I think, between us that he didn't really understand what I want from life in general.

FRENKEL: Right. And I meant my question not so much personally, but whether you think other women in science are faced with that kind of thing.

WU: Yeah, I do think so […].

FRENKEL: I mean it's hard to know if they would admit that about a spouse.

WU: I think so, yeah. I think it's more common than you would see from outside.

FRENKEL: Within marriages.

WU: Within marriages, yeah. And in most marriages, the woman who…if both are busy, it's the [woman] who yields, right? Okay, I'm going to take a less-demanding job and things like that. I'm not saying there's anything wrong with it. There's really nothing wrong with it except if that's not what she wanted.

FRENKEL: Right. So, do you have any suggestions for how…I mean, I guess the day care center that you're advocating is a suggestion for how women may be less burdened…the women scientists and any other working [women].

WU: Elicit whatever help you can get, really, and take it.

FRENKEL: Do you have difficulty recruiting women to your lab or do you not have to recruit to get people to come to your lab is another way of putting it. I saw a few women in the lab.

WU: Yeah, yeah. We do have…I didn't have any problem with that.

FRENKEL: So, they come to you because they're on rotation.

WU: Most of the time, yes.

FRENKEL: They're on rotation?

WU: Yes […].

FRENKEL: And then you said that there was this huge attrition between graduate student to PI.

WU: Right.

FRENKEL: So, what about postdocs who are women?

WU: A lot of…actually, there's still a lot of women postdocs.

FRENKEL: So, then maybe it is the leap to PI where they fall out?

WU: I think so. I think so. There may be some every step, but I would say the most obvious is at the PI level.

FRENKEL: Do they ever approach you and ask you woman-to-woman how to manage the move from postdoc to PI and other things like we've been discussing?

WU: Sometimes, yeah. Sometimes I do get those questions, yeah. Well, usually what I say to them was to really make your priorities straight. You have to prioritize. Just be very honest with yourself what's important for you and then you just have to do it that way.

FRENKEL: Well you…sorry. Did I interrupt?

WU: No, no, no. It's just for example, because of the time [constraint], there [are] certain things that I want to do, but I'm [waiting] until I actually have more time. For example, involvement with the companies or involvement also with China; I would like to contribute to that, but I'm trying to keep things focused, so that I don't lose my bread and butter. Everything else I hope will come later […], when I actually do have the time.

FRENKEL: I lost the thought.

WU: Sorry.

FRENKEL: That's okay. I'm going to put it on pause for just one moment. Well, I lost that thought, but we hope it'll come back before we're done. I know it had to do with a follow[-up] question on women in science. But anyway, I wanted to ask you about a few awards that I see on your resume that I thought were kind of interesting and I didn't even know existed. For example, you got the Mayor of the City of New York's award [Mayor's Award for Excellence in Science and Technology] for being an excellent scientist. It's called the Mayor's Award for Excellence in Science and Technology in 2003. There's the Margaret Oakley Dayhoff Award in biophysics also in the same year, and the Rita Allen [Foundation Scholars Program] Scholar award. Maybe you could talk about those awards that followed the Pew and what they meant to you.

WU: They meant a lot to me. I would say more in the recognition category. [The] Rita Allen Scholars also comes with money; the money was important, but it's more […] the recognition […] that…the fact that I'm trying to do a job and I'm getting at [least] some recognition on that aspect.

FRENKEL: Some of them did come with money you said?

WU: Yeah, Rita Allen came with money.

FRENKEL: How big is that award?

WU: Fifty thousand dollars a year, I think.

FRENKEL: That's nice. Oh for…

WU: Yeah, Fifty thousand dollars a year. For two years.

FRENKEL: Oh, very nice.

WU: Well, it should be for three, but I got tenure before. They had the policy they don't support tenured professors. I [had] gotten tenure before that.

FRENKEL: When did you get tenure?

WU: 2003.

FRENKEL: Oh, great. Okay. So let's see. What I wanted to ask you about broader questions about science and science literacy and education in this country. Your boys are…

WU: Eleven and fourteen.

FRENKEL: Eleven and fourteen, and I'm wondering what kind of science education you see them in getting in the schools at Westchester and what you think of it.

WU: Yeah, in general, I think science education is weak in comparison with what I got from China. I feel [China has] more…certainly in terms of math—definitely math; I'm not sure about science, [but]…definitely math. We've gone through a lot more rigorous training there. I don't know if the curriculum is easy because they just [want] everyone to [take] part. In general, the curriculum is very, very simple and they don't really challenge the students as much.

FRENKEL: What do you think we can do about that in the States?

WU: I think you have to…I'm not sure. But I think you have to somehow [be] willing to challenge the students. I think there is a sentiment in school that you really want students to be happy and every parent to be happy. If you're…that's extremely difficult, it's not a popular move, certainly. Maybe you think math should be divided into different levels. I mean, not everyone needs to be trained as much I suppose, right?

FRENKEL: That's true.

WU: I think they do do that in high school. So, my older [son] is in the so-called honor[s] math, but even [in] that [class] he says everything was very easy. There is, […] in my son's school…there's a recent incident in which one teacher, I was told, was let go because she was giving difficult questions, I guess, and then the students and the parents were not happy with it.

FRENKEL: In math?

WU: In math. Actually, my son didn't tell me about this. I guess he didn't feel whether they were difficult or not…he didn't feel that it was difficult. But another parent who's more involved with school - she doesn't work, so she knows a little bit more about what's happening there – she said the parents were lobbying to get [the teacher] out of the school and eventually she resigned, I guess.

FRENKEL: Are your kids being taught in science class both the theory of evolution and intelligent design?

WU: Not intelligent design.

FRENKEL: That's not happening in New York yet?

WU: Not yet, thankfully. Oh, that' something…it's too hard to understand. For me it's just way too hard to understand why they would consider intelligent design even as a theory without any backings, right. It's a theory without any scientific evidence. It's very hard to prove or disprove, right? It's hard to disprove, of course. There's just no evidence. It's not a science.

FRENKEL: Do you have any religious background?

WU: No, none.

FRENKEL: And your children neither, right?

WU: No, no.

FRENKEL: Is there anything at all comparable in China today that you know of where intelligent design is entertained in the curriculum?

WU: No, no, none.

FRENKEL: But they do teach the theory of evolution.

WU: Absolutely, yeah.

FRENKEL: Okay. Do you think that scientists should explain to the public more what they do and help the public understand about the scientific enterprise? Do they have a responsibility—scientists themselves—to do that?

WU: The thing is, everyone's way too busy. It would be nice. If I have the free time, that would be one of the things I would love to do. But just finding the time to do that is a challenge. But maybe older faculty who are, sort of, retiring from research should do that.

FRENKEL: Well, that's a good idea.

WU: Yeah. They've already accomplished whatever they want to accomplish and maybe they should have a bigger voice somehow.

FRENKEL: You mentioned to me several times how hard it is for you to say no when you're approached about things, and I noticed that you have all these extramural responsibilities; […] there's the Beamline executive committee an[d] then there's an advisory group on structural biology that you sit on, and you're the co-organizer of the New York Structural Biology Discussion Group.

WU: Yeah, it is a little bit too much […].

FRENKEL: But can you just briefly describe what those groups are?

WU: Oh, okay.

FRENKEL: Speaking of volunteering, that's why I thought of it.

WU: Yeah. […] The Beamline Committee […] helped to gather feedback from users [about] what kinds of things […] should be built on the beamline. [We] have meetings discussing what we need to add to the beamline, what needs to be improved, things like that. Basically it involves meetings and thinking about the particular subject…

FRENKEL: That's going to be discussed? Like picking a topic for discussion?

WU: Yeah. Oh, not really picking a topic, but [trying to think about specific recommendations and how to implement them]. Everything takes energy. I mean you do learn. I also learn from sitting on these committees. Again, it's a matter of priority. Sometimes you have to balance it somehow. I would hope [to] do a little bit less, but I still want to do it, but I would like to do […] less so that I can focus […] more on my research. Every stage I think you have to reprioritize.

FRENKEL: Yes. Now there's been some discussion lately about the fact that Californians voted to pursue [embryonic] stem cell research. I was reading the other day about an article or a blog, I guess, that questioned whether this was a good thing for citizens themselves to decide on the direction of research or…

WU: You mean rather than scientists to decide or [the public]?

FRENKEL: Or the government to decide, that the individual people by referendum would make that kind of a decision. So, I wonder what you think about that, the individual versus scientist versus the government question.

WU: Certainly not the government. I wouldn't think the government should ever…

FRENKEL: Right. Because you mentioned that…

WU: It's a science issue, right?

FRENKEL: What about having people vote as they did in California on that kind of thing? If it went in the other direction—if it had been against [embryonic] stem cell research—what then, right?

WU: Right. Should people have a view in that? I mean my view probably is biased. I would say, yes, you just let the scientists decide. They should be the one who knows what's going on, and they are responsible people. I think they are. And they're the one[s] who know the ins and outs of the implications, right? It's very hard to judge as a common…yeah, if you're not a

scientist, it's very hard to judge the implications of [embryonic]stem cell research, or anything else in that sense I think.

FRENKEL: Do you think there are instances where there should be any limits on scientific inquiry?

WU: There probably should be, I think. Yeah, there should be. There will be ethical issues I guess, which in my mind is very gray. I'm not sure what would be the best…like cloning. Do you really want to clone an identical person? I like genetic engineering in general. For example, if you can make a plant of food, fruit, or whatever grow better or something or more nutritious or anything like that, I think those are all good things. But if it comes to humans, it's…I really don't know. Honestly, I don't know. I don't know what's the best thing to do whether there should be limit. I think there should be some limit, but where do you place the limit is unknown to me.

FRENKEL: Do you think scientists should be the ones to decide those kinds of issues?

WU: Yes, science as a community, but not as an individual. The individual points could be very different. Perhaps, science as a community could decide.

FRENKEL: What about science ethics which falls under philosophy, what about the people who are biomedical ethicists, I guess?

WU: I would say absolutely.

FRENKEL: Would they be within the…that would be within the group?

WU: Yes, I would say yes.

FRENKEL: They fall within the scientific community.

WU: Yes, yes, I would include those, yeah. What's your view on that? I'm curious.

FRENKEL: Well, I'm not really supposed to participate in the interview.

WU: [laughter] I'm just curious.

FRENKEL: What I think is the key word here in what you said was community and I do think biomedical ethicists are part of the scientific community.

WU: Agree.

FRENKEL: And they do spend their time looking very closely at research and do understand the nature of research in scientific inquiry. So, I think, that it's more their job than research scientists to explain those issues to laypeople.

WU: Yes, that would be great. Actually, that would be great, yeah.

FRENKEL: They could be the ambassadors. I think what we're seeing here is a need for…

WU: People to understand, yeah.

FRENKEL: …more people to explain to the public, which is to an extent what I have done as a journalist as a science writer. I want to be the translator to the public. And bioethicists also are because, after all, they write and maybe their work needs to be a little more accessible than it is. But I haven't kept up on whether there are any very popularized books by bioethicists out right now. I haven't really kept on that, so I can't say they're not doing it. But my view on whether there should be limits in scientific knowledge or inquiry, I think I agree[s] very much with what you said. Plants are okay with me. Plants are okay. I'm little less concerned about the threat people have raised about…

WU: Tomatoes or something like that, right? Yeah, I don't mind that, yeah.

FRENKEL: I mean, maybe there will be problems digesting them. But it seems like to separate out the plant and the animal kingdoms in terms of cloning is a pretty good way to define how things could be limited. So, I guess, I agree with you. Okay, so back to you, unless you have a further thought. You looked a little pensive.

WU: I was thinking about something. I lost it somehow. [laughter]

FRENKEL: Now I'd like to talk a little bit about the globalization of science.

WU: Oh, I was thinking about this. I know what I was thinking about. I was thinking about how when I was growing up, somehow the whole society…even when I was growing up, even though with all these anti-intellectual sentiment from the government and such, there are a lot of journals. We had a lot of journals that just deal with science or health…science and health. Here I really don't see…here the most popular journals are probably sports.

FRENKEL: Oh, you mean magazines.

WU: Magazines. Yes, that's what I meant. Sorry. Magazines. Things that you […] read regularly. Sports plays a less of a role, I think. I don't remember ever subscribing to anything [about] sports or beauty.

FRENKEL: Well, that's…

WU: It's a part of the culture I think. There, we…no?

FRENKEL: Well, I shook my head, and I shouldn't have done that. But the reason why I did is because science writing and science journalism…it has waves of activity. In 1980, 1981, and 1982, there was a rash of science magazines that came out and technology magazines. And the science magazines were whittled down and now there are fewer. But there was a time when I…

WU: Oh, I see. When you were growing up.

FRENKEL: …when I went into the field there were many, many science journalism outlets, magazines, and science sections to newspapers.

WU: What happened?

FRENKEL: And they have been cut back.

WU: Why though?

FRENKEL: Well they have been cut back in newspapers partly because they're not directly related to advertising space. A science section may not get the kinds of ads that can support the pages. So, it's a business decision.

WU: Right.

FRENKEL: But also newspapers are not as much family-owned as they were, and corporations have taken them over, and they're very bottom-line oriented. And then there's the mood of the country where Christian Fundamentalists have insisted that certain points of view be given equal space and that creates all kinds of problems for journalists in terms of how they report. But I don't want to…

WU: Right.

FRENKEL: It's a whole other…I can tell you that when we're done.

WU: Okay.

FRENKEL: I can spend time on that when we're done if you want. Just back to you for a few more minutes. So, if we could speak about globalization and science, it interests me that you mentioned…I don't know if it was while the digital recorder was on, but you did mention to me at some point that you return to China every so often to teach. I'd like to know where and what you teach, and you also mentioned that you might want to do more of that.

WU: Yes.

FRENKEL: So, that's interesting, that […], ebb and flow of scientific knowledge across borders.

WU: So, right now I teach this Bio 2000 course at Shanghai Institute of Biochemistry which is part of the Chinese Academy of Sciences, and then also at Tsinghua University and Peking University. I teach the same material, actually, on structure biology.

FRENKEL: And how often do you do it?

WU: Once a year.

FRENKEL: So, you're gone for how long?

WU: The teaching is a week. I [go] first to Shanghai and then I go to Beijing to teach. The teaching is a week, but usually I stay a little longer. I visit the institutes around.

FRENKEL: I'm sorry.

WU: Oh, sorry.

FRENKEL: Each institute gets a week-long workshop?

WU: Oh, no, no, no. I only give two lectures.

FRENKEL: Oh, it's lectures.

WU: Right. I give two lectures, two in Shanghai and then two in Beijing, one day in the middle is traveling.

FRENKEL: And you mentioned that you want to do more of that.

WU: Well, more of that. Perhaps, also research. Perhaps have a part-time lab somewhere. Actually, I have sort of started to get involved with some labs in China. So, what happen[s is] people start to ask you to advise the Chinese universities […]; from there, they start to have these initiatives of trying to include you in their daily activity. Currently I'm in the process of setting up a part-time lab with the Institute of Biophysics; […] I'm still trying to think how am I going to do that, exactly how I'm going to divide my time, and [so on].

FRENKEL: And what does Cornell think of that?

WU: I haven't told them. [laughter] But I think they will be okay with it. I don't think there will be any problem with that. These are not paying jobs. No, no, I would still be 100 percent full-time faculty here. But I might have a part-time lab there in which the students have paid and the research money [is] paid, but [I am] not paid.

FRENKEL: Now the Institute of Biophysics is part of a larger…

WU: Chinese Academy of Sciences.

FRENKEL: Wow.

WU: Because I really think our involvement, even though part-time, does not just benefit our research, but [even] more benefit[s] their research because it brings…because we are here [in the US]. We're exposed to more of the more current…more of the updated knowledge in the field. Hopefully, that's the idea. We can contribute to the development of the institute in structural biology, including training the students as well as the PI there.

FRENKEL: So, there would be a part-time PI or a PI who would be full-time but you would be part time supervising the PI?

WU: Well, just being there. No, no, I wouldn't say supervising the PI there…interactions.

FRENKEL: Interactions.

WU: And collaborations, yes, yes. Through collaborations hopefully we can contribute to the quality of the research there, because China [does] have money, a lot of money; the question is how to […] take off. That needs some direction I guess.

FRENKEL: How much money do you think it would cost to set up the kind of lab you have in mind there?

WU: It's vague at the moment, but there is a budget of several million U.S. dollars for several of us. Right now the team has six people. I mean the thing with China is that everything is very…well, it's exploratory, so we have to see how it develops because […] there's no set protocol. You have to along the way try to influence or try to actually think about what would be the best [way] to help…the major goal is to help China to take off, really.

FRENKEL: Did you have to write a grant proposal?

WU: No, no, no.

FRENKEL: No? They came to you with a…

WU: Well, it's basically the government is providing the money for this kind of thing.

FRENKEL: But who decides on what research will happen there?

WU: Oh, the research will be you do whatever you want to, which is nice. Yes, so that's better than NIH, right? [laughter]

FRENKEL: Well…isn't better than NIH, you said. Okay.

WU: Disregard that.

FRENKEL: So, do you ever think you might return to China?

WU: Completely…I can't really see that far at the moment.

FRENKEL: Do you know other Chinese-born researchers who had amnesty like you here who are going back?

WU: Yes, absolutely…a lot of them. It's a big wave at the moment.

FRENKEL: Like how big a wave?

WU: It's a huge wave. […] It's the beginning of the biggest wave I think ever since the Tiananmen Square event.

FRENKEL: To return home.

WU: To return home. So, in the earlier years, some Chinese scientists who are trained here or in Europe go back to China and set up labs there. But now it's the best…actually, a lot of the best scientists are going back and that's really the new thing. That's really the new thing.

FRENKEL: How do you measure them as being best?

WU: Well, they're established full professors here in the States at really good schools like Princeton [University], University of Chicago, Harvard [University], all these great places, they're trying to go back to become…trying to set up a new institute.

FRENKEL: Not even a lab, but a whole institute.

WU: Institute, yes. They're setting up the whole thing, and the government is giving them money to do it.

FRENKEL: Wow.

WU: Yeah. New institutes.

FRENKEL: And is that relatively new in the last year or two?

WU: Yes, that's all.

FRENKEL: That recent, last…

WU: Very recent, yeah, very recent. It's still developing at the moment […].

FRENKEL: The wave has not crested.

WU: For the biggest jobs, if you want to go back and set up institutes, it's plateauing I think. But there are a lot of…if you want to go back and do research, there's still a lot of openings. All these institutes [want] to hire people, but if you want to become the head of the institutes […], it's a little late…almost…a little late almost yeah,

FRENKEL: Oh, I see.

WU: Yes, it's really exciting, actually. A lot of my friends, same age, my age, or sometimes even a little younger, all become these…it can really make a huge difference. That's the exciting part of it. If I were completely single, I would really consider it. [laughter] But realistically, I really cannot do it.

FRENKEL: Yeah, it would mean separating from your kids.

WU: Yeah. No, I can't do that. So, for me it's with half of my ear open keeping opportunities open but not really doing too much…try to limit my activities to that extent. Also I'm not really an administrative person. I think the best way for me to contribute is still along the line of research rather than trying to be a spokesperson for a whole institute and really get buried in a lot of other activities. It's hard because there is a lot of bureaucracy in China…a lot of it. […] The whole system needs to change, and it's not going to be easy. You really have to be truly dedicated. The people I know who are doing what I was telling you about sometimes […] just left their famil[ies] here; the wife will be taking care of the kids and they'll be full-time there. It's [a] sacrifice. It is a sacrifice on their part as well.

FRENKEL: Wow.

WU: Yeah, it's a sacrifice on their part. But they feel that it's so exciting that they go for it.

FRENKEL: Are there any women who are doing it?

WU: Not that I know of.

FRENKEL: Not any women.

WU: It's all men. [laughter]

FRENKEL: I heard of one woman who went back to set up a lab in Shanghai, but it was a pharmaceutical company, […] Glaxo[SmithKline], that financed her, so that was a different scenario. That was a multi-national pharmaceutical financing her in another city.

WU: I think I know this woman, probably, yeah, […] I might know who you're talking about.

FRENKEL: Could you be lured by a pharmaceutical that gave you everything you wanted without all this grant writing?

WU: I would, actually. [laughter] I could.

FRENKEL: And move back to China?

WU: Well, move back…not right now. Not right now. I have to wait till the kids are grown, if I go back. But no, it doesn't have to be a pharmaceutical because research lab, even these institutes, are paid…actually these faculties…if I go back to China now for many years I don't need to write grants. I would not need to write grants for many years. It's really just not practical right now.

FRENKEL: Right, for family reasons.

WU: For family reasons, yeah.

FRENKEL: Okay. I think that's…

WU: At some point I actually am interested [in going] into industry […] because I feel like being a structural biologist for say another ten years […], I would have accumulated a lot of

knowledge, which would be useful for drug design or drug identification and things like that. Yeah, I would like to use those things for something good.

FRENKEL: We have […] really [already] discussed […] the final questions […], which [are] your future professional goals. You're entertaining a lot of different possibilities for when the children are older and in college. In terms of where you are now, maybe you can [assess] your efforts so far in achieving what you have achieved now…

WU: You mean assessing. Oh, how much I have achieved?

FRENKEL: Yeah. Are you content with how much you've achieved. Maybe we should ask it this way. What is the greatest joy you've experienced as a result of your work, and then conversely, if there are any, great disappointments up till now.

WU: Up till now. The joy is many, really. [laughter]

FRENKEL: Your great joys?

WU: Yeah, joys, yes. It's really every little discovery. I mean it's like…I think, I never feel that I'm mature. [laughter] I think am absolutely one of those who never grow up. I like the process of discovery and also not just my own discovery. Also, I'm always excited about other people's discovery as well. Even if I heard something great in seminar, I just get excited. I say, "Oh, wow, this is cool," things like that. I think those things really carr[y] my day. That's what really makes me happy just to be learning things. I guess learning things, also, learning what's going on.

FRENKEL: Let me ask another way. What drives you?

WU: What drives me? Yes. What wakes me up are these things. […] These things […] wake me up.

FRENKEL: What does discovery mean to you?

WU: Right. There's some satisfaction that I can't explain when you find something. I don't know what that is. Do you know what that is when you finish? It's just…I don't know if that

has to do with accomplishment. It's not [per se] recognition. I don't think…those are very collateral points. It's really just the discovery per se. Somehow, I don't know…making new neuronal corrections makes you happy. I don't know. [laughter]

FRENKEL: [laughter]

WU: I mean don't you feel that way as well?

FRENKEL: Oh, yes.

WU: If you finish something, right, it looks good or something, it just make you happy.

FRENKEL: Oh yeah.

WU: Yeah. And I don't know what it is. Somehow that keeps you going, right? Yeah.

FRENKEL: Okay.

WU: Curiosity. Maybe that's what it is.

FRENKEL: And any disappointments that…

WU: Disappointments, yes.

FRENKEL: Career disappointments?

WU: Yeah, I'm sure there are. I'm sure there are. I think [at]every stage there [is] always […] something that you feel […] maybe you could have done [better]. I felt, for example, […], as I told you earlier, […] I felt [that if I had taken] control of my hands a little earlier I could have done better both in graduate school and in my Ph.D. And I mean the other aspect that I feel like I could improve upon a lot would be had I known a lot more about the field in general, the whole biological field in general, right at the beginning of my career. For example, I get into…I love what I do. There's nothing wrong with it. But I really didn't have a general […] very

thorough knowledge […]. Getting into virus crystallography was kind of…it's actually great. There's nothing wrong with it, as I said. But I [got] into it without really knowing what's the rest of the world out there. And same is [true] now. When I started my lab, I spent…in fact, before I started my lab, I spent days or weeks in the library just […] think[ing] about what […] I want to work on because I didn't want to continue my postdoctoral research. I wanted to do something different for my…And I feel that the weeks that I spent in the library were very fruitful. I actually switched…thematically, I switched from what I was doing in Wayne's lab and I was, I would say, successful in what I did. Now I feel like I'd really want to spend another few weeks in the library again, and I'm not finding the time to do it. [laughter]

FRENKEL: Okay. I hate to end on a down note, so rather than leave it with that last question…

WU: But I think the thing is you never have enough time to do what you want to do. I'm starting to accept that to some extent, that if you really want something to be done, just cut everything else. You just have to go for it and do it.

FRENKEL: You know how at one point we were talking about the gallery and I made that mistake about who took the shots? I couldn't help […] noticing [them …]. […] I look at these structures of molecules and proteins […] you've discovered, and I see the computer graphic renderings on a screen; to me they're […] mysterious and they're beautiful […]

WU: Yeah. They are.

FRENKEL: After you have all [those] data that [come] from the synchrotron and then you see the computer graphic rendering, what happens to you when you see the molecule take shape?

WU: You get a huge kick. It's like, "Yeah." For example, if you get your first map, right…electron density map, because you have to build your molecule into it, right? If I see something that is buildable…that I know how the molecules should go within those densities, I probably will spend the whole night building it; […] I have done that a million times. You can't stop it. You can't go back home and sleep. You really just want to see it, how this thing going to look […]. You just want to see it.

FRENKEL: Did you ever get very surprised at a shape?

WU: Oh, yeah, yeah, yeah…most of the time, actually.

FRENKEL: Most of the time you're…

WU: Most of the time, yeah, yeah. It's never what you think. And that's one great kick.

FRENKEL: Wow. So, there's a lot of mystery.

WU: Oh, a lot of it, yeah, a lot of it. And that's really the fun 'cause there's some—now you just think, "Oh, how can this be?" and then you try to understand how it can be. Yeah, it's really fun. It's really fun.

FRENKEL: This is the last question. […] Is there anything I didn't ask you about that you want to bring up?

WU: Right. I can't really think of anything. [laughter]

FRENKEL: Okay.

WU: Yeah. Maybe when you give me the draft, I'll reflect…

FRENKEL: The transcript?

WU: Yeah.

FRENKEL: Sure.

WU: We talked about a lot of things. I don't…

FRENKEL: We did cover a lot.

WU: Yeah, we covered a lot.

FRENKEL: Okay. So, then I thank you so much for your time and everything.

WU: I enjoyed everything.

FRENKEL: You put [a lot of] energy into the interviews.

WU: Thank you. Yes, yeah.

FRENKEL: You're welcome. Okay.

[END OF AUDIO FILE, 2.2]

[END OF INTERVIEW]

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