Chapter 31

RICHARD A. GOLDSBY

Amherst, Massachusetts

July 24th, 1996

VM = Vivian Moses; RG = Richard Goldsby; SM = Sheila Moses

VM: We're talking to Dick Goldsby on the 24th of July, 1996 in Amherst, Massachusetts.

Dick, can we start by finding out from you what your early career was in chemistry or whatever it was before you went to Melvin and how you came to join Calvin's group?

RG: Sure, I had been an undergraduate in Chemistry and Biological Sciences at the University of Kansas and I didn't really hear of Melvin until I took Organic Chemistry and in Fieser's organic textbook he footnoted a number of famous chemists and, of course, Melvin's name appeared there and I was intrigued by some of the things I read there and read a bit more about him. By the time I graduated from Kansas and gone on to an industrial job at Monsanto, I knew I wanted to go back to graduate school and I became very certain that Melvin was who I wanted to work with. So after a little over a year at Monsanto in St. Louis, I got into the Chemistry Department at Berkeley and showed up in California.

VM: As a graduate student.

RG: As a graduate student, announcing that I wanted to work in Calvin's lab. It was then pointed out to me by, it may have been Ken Pitzer, I think it might have been Pitzer who chatted with me and the new students at that point, that the way we do it here is you take a leisurely introduction and you take a good deal of time to decide who you are going to work with and we really don't expect you to jump into a lab.; you take at least three or four weeks before you get started on serious work here. It is very different from the way we do it now, incidentally. You are really expected to be at the bench and doing some research within a month of the time your feet hit the ground in Berkeley. And so I talked to people and it didn't change my mind. I knew I wanted to talk with Calvin and after I met him I really knew I wanted to work in his laboratory. I was assigned to a space in the Old Radiation Laboratory.

VM: Just a second. How did you meet Calvin actually for the first time? Can you remember the occasion?

RG: Yes, I do. He was one of the faculty members I was to talk to in order to decide in whose laboratory I was going to work. He was in his old office in the Chemistry Building. It was a very large room and I can now remember he had these floor-to-ceiling bookcases, and it was about a storey and a half inside the office itself. He was an incredibly energetic and interested man. I later learned how interesting a man he was. He was an incredibly interested man and whatever you wanted to talk about he would dive into it with real enthusiasm. I remember he was interrupted three or four times during the course of our talk, somebody wanting this, asking this question. At one moment someone came in wanting a particular compound and I remember Calvin coming around the desk, scampering up on a ladder, reaching back amongst some bottles at the top, digging something out and handing it over to this person and then chuckling, "How are they ever going to find all this stuff when I kick?"

VM: This would have been around 1958?

RG: This was definitely 1958, September 1958, yes.

VM: Did he ask you what you wanted to work on?

RG: Oh, he presented a number of problems. And, of course, I made the mistake of going to him thinking I knew what I wanted to do. It was a terrible problem but he let me get started on it, anyway, for about 3 months.

VM: What was the problem?

RG: I wanted to look at DNA and ageing. I wanted to see whether or not there was any correlation between the persistence of DNA and ageing. So I wanted to follow a piece of DNA from a young state into a time when the cell, or the organism, had aged to some extent. I remember Calvin saying, "You know I have been waiting to get into this business and I just can't wait to and Messelson and Stahl have done this work. Let's do it!"

VM: Why did you think that he was the relevant person for that? He had had no DNA experience, really, by then.

RG: I was so unsophisticated I didn't know about that sort of thing, thank God.

VM: Anybody could do anything...

RG: Anybody could do anything. And that was an unusual thing about the lab., as you know, Vivian. In fact, anybody *could* do anything. If you could do it, and wanted to do it and you could get organised to do it, you did it. It was wonderful that way. But you could go very, very far astray.

VM: So you actually started working on it?

RG: I actually started working on it and worked on it for about two or three months and I remember there was a young fellow named Rod Park who had come up from Cal Tech and his responsibility was to do science and to run the algae lab. I can remember talking about this with Rod and Rod sort of clucking that I had experience in this and it would work and so forth and me stubbornly going on for a couple of months and then coming to my senses.

VM: And then what happened?

RG: Well, then I took up a problem that a fellow named Moses had worked on there for a bit. I was terrified by the quantities of tritiated water.....

VM: Did you pick that up?

RG: Yes, I did. It was a matter of working with a couple of curies of tritiated water and I did one or two of those experiments and decided that I wouldn't live to complete them. I decided after a number of conversations with Gabriel Gingras, who taught me an awful lot of plant physiology and introduced me to hydrogen adaptation in photosynthesis, that I wanted to look at the path of hydrogen by using hydrogen-adapted algae and got working on *Scenedesmus*. Fortunately Gabriel was willing to join me on that and we had a great deal of fun with that. It went very well.

VM: Are you still in touch with him?

RG: Yeah, we saw him and his wife, I guess a year or so ago.

VM: Where is he?

RG: He's at Montreal University in Montreal, and I invited Gabriel down and he gave a nice seminar — I guess about two years ago, actually.

VM: He's in biochemistry, is he?

RG: He is in biochemistry and he is a full professor there and so forth and has a wonderful little observatory on top of a lovely house in Montreal.

VM: So your first working space was actually in ORL?

RG: First in ORL and then I was moved to LSB where I stayed for the time I was there.

VM: In ORL, itself, were you in the big lab.?

RG: I got a desk and sort of did some work in the main room and then shortly after that we moved to LSB, the Life Sciences Building. There is something I really do want to say, Vivian...

VM: Please do.

RG: ...because there was an unusual aspect to my career in Calvin's lab. as there would have been for anyone of my racial background at that time. This was 1958; it was five years before the Civil Right Act, six year before the Civil Right Act was passed in the United States and it was a time when there was widespread segregation. I am struck by fact I went to Berkeley and I never felt, at Berkeley, any kind of racial discrimination or racism. I interacted with faculty there, a favourite of mine was Professor Cason who had a southern accent so thick you could cut it with a knife, and it was only after I had been in Calvin's lab. for a couple of years that I realised that a book I had looked at (I think it was *Electronic Interpretation of Organic Reactions*, or something like that) was a book written by a guy named Ferguson who is black and who had been a grad. student of Calvin's. Calvin didn't put his arm around me and say "You know I'm a great fan of the black people and I've had a black student and you'll fit right in; we know how to treat black students here." He just treated me like anybody else with one very important exception, which I think is true of a number of graduate students, and that is: he and Gen seemed to watch the students and find out what might be needed. I was desperately poor at the time and people always made sure I had enough work so that I could support myself. They arranged a kind of teaching associateship there where I got paid 12 months a year and, of course, I worked as a research associate in the laboratory so that was taken care of. Gen would invite my wife and I up to the house and we would have lovely meals there. She made a point of remembering every graduate student's name. No matter when you called Melvin he would somehow make space for you if you were a graduate student; you'd get in to see him. Post-docs. often had great difficulty seeing him but when a graduate student called they got in. Of course he had, for Berkeley, a small number of graduate students — there were only eight or nine of us at any given time. And I remember he also insisted on teaching an undergraduate course, something called Chemistry 8, and I TA'd on that course for a number of years, for two years for him...no, I TA'd in that course for all three years, actually. I was there for almost three years. He did essentially all of the lecturing in that class in spite of his travelling.

VM: Was he a good lecturer?

RG: Very good lecturer. And we graded the exams but when the time came to assign grades we would come in, all the TAs, and we would tell what grades the students had made and before assigning the grade, particularly if it was anywhere near a line, Melvin had go back and forth and we would chat about it and that sort of thing. I never saw a student lowered but sometimes one would be brought up to some extent. And then after that, something that didn't strike me as at all unusual at the time — I was grateful for it but it didn't strike me as unusual — I lived in what was called the "incubator," which was married student housing about 3 miles from campus. It was called the "incubator" because so many graduate students had these large families out there.

VM: Whereabouts was it?

RG: Out in Albany, California, a town just over from Berkeley. I always bicycled to the University but Melvin always insisted on giving me a ride home. Again, at that time I thought it was nice but it didn't strike me as anything extraordinary. Having students myself and being in that situation I know how rarely I do that sort of thing now. So you had this person who had a reputation around campus as being a real bear. Melvin was not loved outside his own group, as you know. He was a terror as far as people around campus were concerned.

VM: Well, they were afraid of his perception.

RG: They were afraid and I think sometimes for good reason. He had given them reason to fear him. He could be very difficult and very outrageous in terms of the way he would treat people. But in the group, itself, and it was a huge group — it must have been about 60 people — I never saw that, never.

VM: I don't know how big it was at the time you first joined it but certainly by later years it got even bigger, up to about 90.

RG: It was enormous. Now, the Friday morning meetings, I've never quite had anything quite like that. The closest thing I had at the Whitehead Institute (that's where I go for sabbaticals, in Bob Weinberg's lab.) and it comes close but doesn't quite do it. One doesn't have quite the kind of intellectual breadth that one had in the Radiation Laboratory. But as you recall the way those meetings were done, two people would present, you would get up and you would present your research and you would get stopped every other sentence, sometimes by Melvin and sometimes by another person in the group. And you had to stop right there, dead on a dime, justify your reasoning, demonstrate that you knew what you were talking about, that you had read up on things and it was just a wonderful session and you learned an enormous amount. And as you recall, those were held whether or not — they started at eight o'clock in the morning on Friday and Melvin would look around the table and he would say out loud, "Where's so and so? where's so and so?" and even though attendance wasn't taken if anybody told you Calvin was asking for you, you got very worried and you made sure you didn't miss again.

VM: But by the time that you had joined people were getting notice of their obligation to give a seminar. It wasn't still at that point where he just sat down on Friday morning and looked around the table and pointed at someone and said "you".

RG: No, it wasn't done that way, thank God. You did have some time to prepare.

VM: You had about a day's notice, I think.

RG: Yes. They would tell you during the week you were going to talk this Friday and you would get ready and get up there.

VM: So you found it personally an invigorating experience and helpful — helpful to your own work?

RG: Extraordinarily. Helpful to my own work and I learned an awful lot. Of course, I was terrified when I had to talk. That's the way things were done at Berkeley at that time.

VM: Well, in Calvin's lab.

RG: Of course. After you had survived two or three of these things, well you got kind of cocky and accustomed to it and you sort of looked forward to showing off a little bit.

VM: Who were the graduate students in Calvin's lab. with you at the time?

RG: Well, there was Jan Anderson...

VM: Ah; she was a graduate student. I'd forgotten she was a student. Was Biggins there when you were there?

RG: John Biggins came while I was there; we were contemporaries. Of course there was Gabriel Gingras and Gabriel and I did a lot of work together. And there were others whose names I'll remember if you prompt me but I'm getting to be an old codger now and I don't remember everything.

VM: Well, I don't really remember them all. I have lists from Marilyn as to who everybody was.

RG: I remember very well when you came.

VM: When I came back.

RG: When you came back, and I thought that very well typified that kind of interaction that we had. You had come, and I think you had just gotten back from a trip to Israel or something of this sort, and there was a movie on Israel on and I struck up a conversation with you and you said you were going up to see this movie and I said, "Can I come along?" We came along, had a fabulous conversation, we got to know each other and interacted a great deal over time. It was the sort of place where you just interacted with anybody. It was very easy to do and you struck up a lot of friendships and a number of collaborations that way.

VM: How did you find this collaborative matter interacted with your obligation to write a thesis?

RG: There was no real problem. I guess I worked on three different problems during the course of my time as a student there and, you know, a couple of times a year I really had to give an account of what I was doing in group meetings and in conferences with Calvin, and as long as your problem was moving along all right nobody really cared what you did so you could have a great deal of fun.

VM: So you kept a sufficiently clear idea of where your thesis was going so that you could...

RG: I was lucky. My thesis led me in the sense of, once I was able to get uptake of tritium gas and demonstrate I could get the uptake and get CO_2 reduction, then, you know, one did the obvious things so the thesis essentially led me right along.

VM: You said a bit earlier on that you decided you wanted to stay alive and therefore didn't want to work with curies of tritium. So I don't remember the details at this point of what you actually did. What did you do?

RG: I started off looking at the path of hydrogen in photosynthesis and thought maybe if I could introduce it as tritiated hydrogen gas it might be a little easier to follow than using it as tritiated water — it might go fewer places. As it turned out, nothing was known about the path of carbon in hydrogen-adapted organisms and so what Gabriel and I ended up doing was tracing the path of carbon in hydrogen-adapted *Scenedesmus* under photosynthetic conditions. And the path turned out to be very much what it is in *Scenedesmus* under normal photosynthetic conditions. And so we essentially characterised and worked out that pathway. In terms of rationalising it, I borrowed Arnon's scheme in explaining what was going on. And I remember Calvin looking at that and just dismissing it out of hand because it had come from the wrong place. It turned out to be that was very much the way things were going on.

VM: Did you know Arnon — did you ever meet him?

RG: Oh yeah, I interacted with Arnon a good deal and with Arnon's lab. I liked Dan Arnon a lot but you almost couldn't mention Dan's name in Calvin's presence because he hated him so much. He loved toying with Arnon and making him look foolish. At one time we had joint group meetings for about — oh, we had about three joint group meetings with Arnon's lab. — but it just didn't work out because Calvin just couldn't stand the man intellectually. But that didn't stop me interacting with him and his graduate students and I got a lot out of it. It was that kind of place. The main thing was, were you getting the job done? Were you doing some thinking? How you got the job done nobody really cared, nobody cared.

VM: So you spent a total of what, about five years there?

RG: I was there a little less than three years.

VM: Oh, that was quick for a graduate student. Most of them...

RG: I worked day and night. When my first child was born I took my wife to the hospital, saw the child delivered and was able to get back and finish my experiment.

VM: Being married and then becoming a father, did that — and working so hard — how did you fit in with the social scene in the lab.? How did you perceive the social activities at that time? To what extent were you able to participate in them?

RG: Well, I didn't participate in any social activities to any extent, not because I had any perception I wouldn't have been welcome. It just wasn't something I was doing at that time. I was basically trying to finish a degree.

VM: And you were working day and night?

RG: I was working day and night and Cyril Ponnamperuma, whom you mentioned at lunch, also had a very similar experience to mine in the sense that Cyril came and finished in 2 1/2 years and Cyril worked day and night. Cyril tells the story about how when Calvin took him into the lab., he said, "I'm going to take you to Donner Lab. and I'm going to introduce you to Dick Lemmon," and he introduced him to Dick Lemmon. And then he said, "Now I'm going to take you to the laboratory," and he took him to the laboratory and he said, "You see this laboratory?" And Cyril said, "Yes." And Calvin said, "This is where you spend all of your time. You leave to eat; you leave to go home and sleep; but you spend all of your time here; this is where you work." And Cyril felt a little intimidated by that. But on his own it came to be the place Cyril preferred to be and he did work day and night and weekends and got a hell of a lot done.

VM: That was in Donner, presumably?

RG: That was in Donner.

VM: But you found other people in ORL and later in the Life Sciences Building where you were, who were also working...

RG: Oh, Gabriel and I worked a great deal. We worked all the time. We were not there alone. Jan Anderson worked a great deal. Calvin didn't tell me and he didn't tell Gabriel and hadn't told Jan, "You must work all the time". But we just worked all the time.

VM: Was this very different from the post-docs.? Did they not work all the time?

RG: The post-docs. worked hard. I don't think they worked quite as much as the graduate students did. In many cases the post-docs. had wives or families and felt they the need to spend some time with wives and families. I was an incredibly sexist person at that time and very insensitive, and I didn't care about what my wife thought or was doing. I only thought about my own career and my own concerns, and so I gave no thought to family responsibilities.

VM: So you weren't really in a position to go on mountain trips...

RG: No, I didn't do any of that, an occasional concert, that sort of thing. But I don't want to present myself as someone who felt deprived or unhappy. I had a job to do.

VM: You had a job to do and you wanted to get it done as soon as you could.

RG: Yeah, and it was great fun. It was terribly exciting. As you recall it was an enormously well-equipped laboratory. I remember they bought this mass spectrometer. It was not a laboratory where they would buy these fancy pieces of equipment and nobody could touch it except a specially trained technician or

somebody. They bought the spectrometer and we, as graduate students, and other people were invited to come in and do experiments on it. And it was extremely valuable to me. I got in and ran it myself.

VM: You mentioned your collaboration with Gabriel and you saw Melvin, obviously, on Friday mornings. He was your thesis advisor?

RG: He was my thesis advisor, yes.

VM: Did you get to have personal conversations at any length?

RG: I had personal conversations with him. I could count the times during a year I had any kind of in-depth conversations — maybe five, six times a year.

VM: Did you have to find him? Did he come and look for you?

RG: Occasionally, he would stop by when he came in the lab. and ask everybody how you're doing, so forth and so on, what's going on and a brief conversation there. But in terms of actually sitting down and chatting that would happen a few times, less than half a dozen times a year.

VM: You had to request it?

RG: I would request it. And whenever I requested it, well with one exception...Once or twice a year you would go up to his house and you would have a very nice conversation there, usually not about science, it would be about anything. It would be an interesting table and there would be interesting people there at the table and you would have a great conversation and so forth and you would talk to him about almost anything. Quite often it would be sort of an argument about this, that or the other because he would like to bait you on these things and see what you would say. And he made you feel free to say pretty much anything you wanted to. There were no penalties at these things. I never requested a conversation without getting it but let me tell the whole story, Vivian. I didn't want too many conversations with a thesis advisor because they might have tried to tell me what to do! I wanted a conversation with my thesis advisor when I had results to present and a story to tell. I didn't want somebody looking over my shoulder telling me what to do.

VM: But it was going well, presumably, and so you felt you knew where you were going and how to get there.

RG: Yes. And there were other things I wanted to do aside from my thesis and I wanted the freedom.

VM: When it came to writing the thesis itself, and getting it drafted, did he look at the drafts that you'd written or was that all your responsibility? Did anybody look at the drafts?

RG: He looked at the first draft and thought it was OK. I was rushing because I was trying to get to a job at duPont and I rushed him enormously about that and he got rather angry with me and I remember him snapping, "You can't just expect me to do your bidding at the drop of a hat!" And other people on campus — Bill Dauben looked at it and Tobias looked at it. And Bill Dauben didn't like it and sent me back to the drawing boards on it and bless him for doing so because, as a consequence of Bill Dauben's prompting, I put a much better theoretical section in it. I had no kinetics in it the first time he read it and that sort of thing.

VM: Had you left by then?

RG: No, I was still there. I wrote it much too quickly — it was just one mad dash. I wrote it in a month.

VM: About this period. You say you had a job waiting for you at duPont?

RG: Yes.

VM: How did you get a job?

RG: Melvin had hoped that I would take a post-doc right there in town, in Albany, in x-ray crystallography. I had gotten interested in x-ray diffraction work after Kendrew had published his paper and I thought that was what I was going to do and he had arranged for me to meet this guy over in Albany that ran an x-ray diffraction laboratory.

VM: Was that in the USDA?

RG: That was in the USDA, yes. And I was pretty well all set to take a post-doc. there and then I got to worrying about the family finances. The second child had come by then and an interviewer from duPont came through and I decided I was going to go to work in industry because I wanted to make some money. I had no sense again that it might be hard to get a job at duPont because I was black and the interviewer was there. I needed a job to make me some money so I went to the interview and sure enough they hired me. When I told Melvin (he was a consultant at duPont), he said the part of duPont I was going to, CRD, was a very good place, good people there, but he was disappointed I wasn't going to do the post-doctoral work but it was a good place and when was I going? Well, I thought, maybe three months from now. "WHAT? You haven't even written a thesis!" Well, I thought I could get it all done. "Well, that's an awfully short schedule." Well, anyway.

VM: Was he right?

RG: I got it done but I irritated him because, you know, when I got it done I stuck it under his nose and believe it or not a person who runs a group of 60 and has consultancies all over the world has other things aside from worry about one graduate student's schedule. But anyway it got done.

VM: You also mentioned earlier on, as we were having lunch, that you had been friendly with Karl Lonberg at the time...

RG: Oh, Karl Lonberg and I...

VM: ...and, of course, he also went to duPont.

RG: I told him about duPont and Karl came and looked and liked what he saw...

VM: I see, it was because of you that he went there?

RG: I like to think that I was somewhat influential in persuading him to come, yes.

VM: What was the nature of your interaction with him in the lab.? Just as friends?

RG: Just as good friends. Karl was a very liberal guy — very far to the left...

VM: Very much so.

RG: ...so again, looking at it in hindsight, I can see why Karl...Karl actually made friends with me. Karl is something of a legend around the place but a liberal like Karl sees somebody like me in the lab. and he seemed to like me but a liberal like Karl would see somebody like me in the lab. and immediately he would come to make sure a black person was being treated right and all that. There wasn't any problem. And, you know, it turned out I liked him enormously as a human being — very, very high scientific standards, very smart, granite sense of integrity, a bit of a stick, really, on the integrity part, but he was so much fun you could let that go by. Karl was always a lot of fun; at duPont he was a lot of fun.

VM: So you were in touch with him in duPont.

RG: Oh yeah, we were colleagues, yeah.

VM: You were in the Central Research Department?

RG: We were both in the same group in the Central Research Department.

VM: What have you done since then, since duPont?

RG: I left duPont after five years and went to Yale as a visitor, came back to duPont and then went back to Yale.

VM: They gave you, as it were, a sabbatical or leave without pay?

RG: They let me go for a year and then welcomed me back and then I left again. And spent a very pleasant and exciting time at Yale in the Biology Department there...

VM: As a regular faculty member?

RG: ...as a regular faculty member..

SM: Which year was that?

RG: That was 1966-1970 and then I went off on sabbatical to Harvard and then came back and they made me Master of College at Yale. It was apparent to me that I wasn't going to get tenure at Yale — I really didn't deserve it — but I could have stayed on as Master of a College there.

VM: Which means what?

RG: It is very much like Master of College at Oxford or Cambridge.

VM: Oh, I see. A residential college?

RG: A residential college and we set some of our own courses we offered and that sort of thing. As you would perceive, at that time the United States it was very much like it is now or even more so. Being a black person who was in the sciences, there weren't many of us and socially-conscious institutions were very interested in having some of us around. So Yale would have kept me around as a Master of a College or something like that. But there was an opportunity to go to the University of Maryland and remain in science, which I much preferred to do. Cyril was down there and Cyril really greased the rails and arranged for me to come to Maryland. And so I was at the University of Maryland for ten years, although I spent three years of that time out in California at NASA at Stanford.

I left Maryland for a Chair at Amherst College, which I occupied for, I guess, about four or five years, and then they asked me to come to the University of Massachusetts.

VM: That was about when that you came?

RG: I came to Amherst in '82 and I came to U. Mass in '85, I guess it was, '86, and was at U. Mass from '86-'89 when I went back to Amherst as the Simpson Lecturer and Professor and have been there ever since. I still hold a joint appointment here at U. Mass and I get my graduate students from U. Mass and my undergraduates at Amherst. Amherst is a wonderful little college, as you know. And U. Mass has some very good departments and some very strong departments. It is a very nice set-up that I have between the two places here now. I think I have finally found a home here.

VM: What manner of contact have you retained with the group in Berkeley — the people or the place itself?

RG: The last time I saw Calvin was 1983 when I invited him to come here and give a seminar. He came and gave a couple of wonderful seminars, one being a public lecture on the use of the *Euphorbiaceae* as the sources of oil. That was a general public lecture and he really made it crackle and really interested people, the kind of

thing (*where*) you wanted to put down what you were doing and start working on that. And then he gave a straight-forward talk to a combined chemistry and biology group on photosynthesis, which was a wonderful and elegant lecture.

As you know, Melvin was able to make things very clear whenever he wanted to and the excitement just came right through on what he was doing and what he was thinking about. There was a kind of — naive is a term I hesitate to use because of the extraordinary scientific capacity and sophistication of the man — but there was a child-like quality of the way Melvin went after things and talked about them and dealt with them. It always told he was interested because he was just open and unbridled, he wasn't trying to protect himself at all when he talked about something he was really fascinated in. And when you combine that with a kind of extraordinary — he was very, very smart and very, very quick and knew an enormous amount — he could quickly synthesise all kinds of things. It was just a wonderful performance.

I remember once when we had him back for a seminar at the University of Maryland. one of our younger physical chemists made the mistake of thinking he was dealing with what the physical chemists dismissively called "biochemists"! Melvin was giving a lecture on photosynthesis and, of course, when you are talking about processes in photosynthesis you don't write balanced equations, for God's sake, you put down reaction flows. And Melvin was showing flows of reactions in carbon and so forth and I remember Miller stopped him and said, "Uh, uh, pardon me, Dr. Calvin, but you know I'm not a biochemist and I usually deal in balanced equations" — and Melvin was putting something speculative up about interactions between manganese and oxygen-like driven(?), a rather complex piece of chemistry — "and I can't really understand that reaction unless it's balanced". And Melvin flashed, you could just see the anger flare. It happened for just a microsecond, just like that, and then he calmed down again and he said, "You wait for your electrons for just a moment or so," and then he went on with the lecture, all the time, I realised, working this out in his head as he went through the lecture. At the end of the lecture he wrote off this elaborate balanced equation and said, "There are your electrons, are you satisfied now?" The audience was just stunned, just stunned. And, of course, Melvin could do that sort of thing. I remember when he was here for the lecture, we didn't want to burden him with a lot of conferences with people so when he wasn't actually talking Barbara and I just took he and Gen around the area and had a couple of very nice days wandering in and out, here and there, going to tops of hills and taking pictures, that sort of thing. I remember I thought the afternoon had been a little strenuous and I wondered if they wanted to come back to our place for a cup of tea. We had a log cabin at that time and we went in for tea and they commented on the place and how nice it was and so forth and as we were having the tea my wife asked him a question that had to do...my wife is not a polymer scientist she is a very good molecular biologist but she's by no means a polymer scientist. She asked him a question having to do with some aspect of polymer science because she was curious about it. And Melvin sat there with his cup of tea and gave the history of the field, gave its current development, pointed out where it might be going, all in the space of about five minutes. She wasn't a chemist but she understood everything.

So that is the long way of saying he gave a couple of extraordinary lectures here which went over very, very well and by that time I was old enough to really sense what kind of person I'd had the privilege of interacting with. As a graduate student I knew he was smart because, you know, I TA'd for him and I watched him at group meetings and so forth and I knew how he could ask me questions that could give me difficulty. But by the time I was in my second year and so forth I knew the system I was working with better than he did and sometimes I would get impatient with him...well I told you that last time. I wouldn't say that , of course, but I would think, I told you that last time, can't you remember anything? And we'd go on. So, you know, as young people often don't really know what they are interacting with until they look back.

VM: What was TAing for him really like? What did you have to do?

RG: Well, again, it was a wonderful situation because in this course he taught called Chem 8 he didn't have wet laboratories he had discussion groups, instead. His feeling was that students can't really learn chemistry unless they can talk about it and there was no way he could talk about it with 300 people. So he broke it up into small sections and had TAs meet with about 25 or 30 kids once a week when you would really go through in some detail.

VM: The same group?

RG: Each TA would have a group of 30 kids, 25-30 kids, and you would meet with these kids and would go through a list of topics that had been raised in class. So Melvin would have TA meetings and he'd say I want you to talk about this or I want you to check them out on that and I want you to do this and you'd get together with your group of students and you would take them over. Melvin was very clever. He would tell us, "you know how they do on exams is really importantly influenced by the quality of TA they have and the good TAs tend to get their kids to do well and so forth and the ones who don't take a good attitude, their kids don't do so well". What he was doing, of course — looking back over the years I now know exactly what he was doing — he wanted us all to put as much into it as we possibly could. So you got this group of kids, once a week, all in a room all by yourself and you were teaching them. You would kid yourself to think you had a lot to do with how much chemistry they were learning. Well, you did have something to do with it and so you got to really teach. I came to love teaching there and I learned something about how to teach during those years I worked as a TA in his class. So that when I really found myself in front of a class I knew a little something about how to teach it.

VM: The other thing I would like to bring up is where you worked. You worked in ORL and in Life Sciences....

RG: I worked for maybe a month or so in ORL...

VM: But long enough to see what it was like.

RG: To see it was an incredibly decrepit building. I thought it was going to fall in at any moment. The fact that great science had been done there amazed me.

VM: Did you stay with the group long enough to move into the round building later on?

RG: No, no...

VM: Have you been back and seen it?

RG: I have been back and seen it and I have been back and done a little work in the round building. I was on sabbatical; I stopped back and did some work there.

VM: Some people have spoken a lot about ORL and what they think it meant to the way the group developed. How did it strike you? I agree you may have been only in it for a few weeks.

RG: I think I probably wasn't there long enough to be indoctrinated into the mystique of ORL. The thing that people talked about a lot in LSB was the fact we had a big white table that everybody would gather around for coffee or for tea at ten o'clock in the morning and Melvin would often show up at those and, of course, whenever he came the spotlight immediately moved to him and we kind of stood around and listened and so forth and sometimes learned about very new things that he had seen in his travels and that sort of thing.

As I look back from this distance now I marvel at how he was able to juggle the travel schedule so that he was really there for the Friday morning meetings. You essentially saw Melvin on Friday morning, every Friday morning. Now how do you do that with the kind of travel schedule he had? He would always arrange to be around LSB at least once a week at a time that wasn't Friday morning and he had a heart attack while, during the time I was there and I remember they got this golf cart for him and he would go up and down the hill between his office in Chemistry and LSB on this golf cart and so forth. The car would whiz in and so forth. You could drive it right into the lab. there in LSB and he would make the rounds of people.

VM: So even in this place with a long corridor and separate rooms you felt there was a considerable sense of community and the white table was there...

RG: Oh, there was a considerable sense of community. And we just had an awful lot which made us very much our own institute. I guess if there was a down side to some extent to being in Calvin's group, it was that you didn't interact much with the rest of Chemistry. You were very much part of an institute and very much part of a self-contained unit that pretty much had everything it needed. We had our own glassblower — so you didn't have to wait in line to get our glassblowing done — you occasionally went to the Chemistry supply house but basically you ordered things that came into the laboratory there. The budget was unlimited and so you just went to it.

VM: But you did describe how you made your own contacts with Arnon as an outside group.

RG: Right. But he was there in LSB and we needed him because he was a thinker in photosynthesis.

VM: Of course, he was physically very close.

RG: He was right up on the third floor, yeah.

VM: So when you went back and saw the round building and to a degree worked in it, how did that strike you?

RG: It was a magnificent space. One of the best work spaces I have ever seen. Just magnificent.

VM: That says it all, doesn't it? OK. What sort of contact have you had with other people in the group? Because you mentioned you last saw Calvin in the early '80s but have you kept up with other people? I mean Clint, here, is a neighbour.

RG: Here's Clint.

VM: It is a very dispersed group.

RG: Well, I've seen Rod Park a couple of times and had dinner at his house and drank some of this incredible wine that he makes, which is wonderful, wonderful stuff, it really is.

VM: He wants to go back and spend a fair amount of time on his winery, he told us a couple of weeks ago.

RG: I hope so. But as for keeping in close touch with people, no it really hasn't happened. Cyril, of course, we were very close, and Karl Lonberg in his time at duPont we were very close. But aside from that...Gabriel and I lost touch with each other for maybe fifteen years.

VM: But it clearly has been an important stimulatory and educational factor in your life.

RG: Critical events in your life, obviously, as it was for so many people. I just wanted to say a word or two more and just chat a little about Gen Calvin. It wasn't that you saw a great deal of Gen but it was almost routine, when you were in Calvin's office or something, that either he would call her or she would call him. They were obviously close and when you heard the conversation that went on it just told you they were a real working partnership. There was just no question that she made a thing of getting to know something about the personal concern of people who were in Calvin's laboratory and trying to be helpful and trying to be supportive. It meant a great deal when she called you personally, when she actually asked and actually listened to what you were saying. When you saw her for dinner and she was warm and friendly; when you saw her in later years when she was travelling with Melvin — they travelled a

great deal together. When one sneezed the other covered their mouth, it was that kind of relationship you would see between the two of them.

It was a great shock when she preceded him into whatever happens next. I don't think he ever thought it would go that way and I don't think she really thought it would go that way. But I thought she was a very important influence. As I think about the lab. itself, there were other critical things that made the lab. such a supportive environment, I thought. Marilyn, of course, knew everything and knew everybody and was a real white witch, and they are the good witches, as we all know — angels, in a sense. Marilyn was just...she just had to be digitally put together because she never forgot anything and she always got everything done.

VM: She still hasn't forgotten anything.

RG: Just an amazing person and also was a person who made you feel very welcome and a sort of a friend to all the graduate students, I think. And then the support staff we had around the laboratory, people like the glass blower, people who did carpentry or mechanical work that needed to be done. You could imagine a piece of equipment there and within a week you had it working. So you could create an apparatus to do the experiment you needed to do. It was just a wonderful place to work.

VM: Have you come across other places like that?

RG: Yes. The one place I've come across places like that is the Whitehead Institute that's attached to MIT: again, an extraordinary working environment, very, very good people, all the resources you need essentially in one building to get done what you need to have done and a crackling scientific atmosphere.

VM: Was it the creation of one man in the same way the Berkeley group was?

RG: No. It was the gift of Jack Whitehead, of course, who put the money there to let it happen and the fact that he continued to water it during his life and in his bequest and also spiritually to be around to encourage people. It's very much the creature of the six or seven founding members who felt that they were going to get all these egos in a very small space and that what they would have to do is to maintain an atmosphere where people felt safe to be open about their research. So you have people talk about research in progress in an incredibly competitive field like molecular biology and still pretty much be able to say out loud what they are doing to people and have it stay right there. The other thing they have pretty much succeeded in doing is keeping all those egos in check so they don't tear each other apart. The Whitehead turns out to be a rather pleasant place to be socially — it's very cordial, people don't fuss and fight a lot.

VM: It was, of course, founded considerably after Calvin's group.

RG: Oh my, 1982-'83, something like that.

VM: Yes. Perhaps as an example of that sort of thing Calvin's is very early, maybe one of the early ones.

RG: It is very early. And also, I think, very different. Because, as you say, Calvin's lab. was very much the creation of one person. It would not have existed without him.

VM: OK. Thank you very much, indeed, and I hope it won't be quite so long before we see you.

RG: I hope not, Vivian.