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ROBERT WALKER

(with ALBERT TUCKER)

This is an interview on 12 July 1984 with Robert Walker of Pittsburgh. The interviewers are Albert Tucker and William Aspray, interviewing by telephone from Princeton.

Tucker: Let's start with how it was that you came to Princeton.

Walker: I was at what was then Carnegie-Tech; it's now Carnegie-Mellon. I was in engineering, but they had a special mathematics program. The head of that was a very smart, I mean intelligent, but not much trained mathematically, old German named Otto Geckeler, Otto T. Geckeler. He was known to the students as "Zero T". He was an irascible German, but Lefschetz reminded me somewhat of him.

Tucker: Oh yes.

Walker: I got along with him very well indeed. I had no idea that there was such a thing as a professional mathematician when I went there. My idea of a mathematician was somebody who taught in high school. But he told me about the possibilities and encouraged me to go on to graduate work. And since I had been very much interested in geometry there, he strongly suggested Princeton. So my family put up enough money to carry me through the first year, even though I had no fellowship or anything. That was the way it worked. I had a little trouble getting into Princeton, as a matter of fact. I think that in those days old Dean West was kind of fussy about your background. He much preferred people with a more humanistic background, not these hardheaded engineers. I finally did make it in, and after that there was no great trouble.

Tucker: Had you had some Latin or Greek?

Walker: No, I had not.

Tucker: I see.

Walker: I had gone—it's a little funny thing—to a Catholic high school. At that time Duquesne University was running it, and I guess it was what you would call a prep school. They had a couple of different tracks: an academic course and a commercial course and a scientific course. Of course I took the scientific course, because even at that time I knew I was interested in mathematics. Arithmetic was what it meant to me.

Tucker: Yes.

Walker: The scientific course had two hours of mathematics every day for four years. We had one hour of geometry and one hour of algebra or trigonometry.

Tucker: Yes.

Walker: So I got a load of mathematics, but no Latin, no Greek, nothing like that.

Tucker: And that's what Dean West objected to?

Walker: That may be.

Tucker: I had always thought that John Landes Barnes was the first such person to get into the Graduate School. I think Dean West's particular objection was to his living at the Graduate College. I had thought that Barnes was the first one to break this down. He had come from MIT and had no Latin or Greek.

Walker: Did he come at the same time as you? You came the year earlier, I believe.

Tucker: Yes.

Walker: Yes, I wasn't sure about that. I tried to write down a list of all the students I could remember and the years, but I wasn't sure about Barnes. Well, then I was the first non-classical admission.

Tucker: You were the first.

Aspray: Could you tell us something of your first impressions of Princeton?

Walker: I'll tell you something funny. I hadn't thought of this before. I came to Princeton, and I got my room at the Graduate College. Then I walked over to Palmer. As I was walking in, I met a young chap, somewhat older than I was, but he didn't strike me as being that much

older. He started talking to me, and I talked to him more or less on the same level. I found out later he was T.H. Davis, on the faculty. I got sort of a shock when I found out who he was. He had addressed me as Walker, and I had addressed him as Davis.

Anyway, then I went in and met this very nice old fellow by the name of Veblen. He was just charming. He showed me around and introduced me to people. I had a wonderful time. That was my first encounter with the Princeton mathematicians. From there on I don't know there's anything that strikes me as outstanding. You know, we went to classes in various rooms in Palmer, and we played Kriegspiel up in that little room on the second floor. That's about all that really stands out. Of course, I met a lot of people. If you want the names, I can give them to you.

Tucker: Who did you have courses with your first year?

Walker: Well, let's see. I had real variables with Einar Hille, and differential geometry with either Eisenhart or Tracy Thomas, I'm not sure which, probably Tracy Thomas. I think I got Eisenhart only for Riemannian geometry the next year. I really don't remember much else. I must have taken some topology.

Tucker: You took a course from Alexandroff in the spring term. I remember that.

Walker: Yes. I didn't take a topology, I took analysis situs, or as Lefschetz said "analysis situs".

Aspray: How did they strike you as teachers?

Walker: Oh dear, I really don't remember. I liked Hille and the way Hille ran the course. He was very systematic. We weren't using a book. He gave lectures, and Jack Levine took them down and wrote them up. Then we had Agnes Fleming mimeograph them. We got all these stacks of papers to collate. We went round and round and round the table sorting them. I'm sure Al remembers that process.

Tucker: Oh, yes.

Walker: Oh yes, I had some algebra with Wedderburn. Just exactly what sort of algebra I don't remember. It wasn't matrix theory. We didn't get matrix theory until the second year.

Aspray: How was Wedderburn as a teacher? Do you remember?

Walker: He was a little frightening. He was too good with his stuff. I remember a comment of Jacobson's in the matrix-theory course the next year. Wedderburn had been doing some stuff with matrices, and as sort of a corollary to what he had done he proved the whole theory of symmetric functions in about fifteen minutes at the end of the hour. As we were going out of the class, Jacobson said, "Next class, he's going to prove the existence of God with matrices." That sort of thing was overwhelming.

Aspray: Did you attend the early teas before the new Fine Hall?

Walker: Yes, you see Fine Hall was being built when I got there. It was opened in the fall of '31 and I got there in 1930, so I spent the first year in Palmer. I remember on Sunday afternoons we used to go over and explore the framework of Fine Hall as it was going up. And [John] Vanderslice, when they were putting in that famous fireplace, in the Professors' Lounge with the Einstein quotation. Just before they put the woodwork up, Vanderslice wrote a translation on the plaster behind it. I think his translation went something like, 'Very slick is the Lord God, but malicious he is not.' I liked the word 'slick'. I think that's much better than the word 'clever', which is the way it's usually translated.

Tucker: I thought that the free translation was done by Bob Robertson. And the way I remember it is, "God is slick, but he ain't mean."

Walker: No, I'm pretty sure I'm right, Al, because I was very impressed with Vanderslice. He was an impressive person. He was an excellent chess player, and he excelled in anything related to chess. When we started to take up *go*, he caught onto it very fast and became one of the best players. He was of course excellent at Kriegspiel, any of those games, although at bridge he wasn't that outstanding. I guess he was the one of the older students that we first-year bunch really got to know well. He sort of hung around with us. Let's see, [William C.] Randels came in the same year I did. [Nathan] Jacobson came in the same year. Jack Levine, the same year. [Stephen] Kleene, I don't remember; he might have come a year later although I think it was also that same year. And Dan Lewis came around that time, but I'm not quite sure. Within a year or so, one way or the other. But Jacobson and Randels and Levine and I all came that same year.

Tucker: Talking about Vanderslice, were you present the time there was a contest in which Vanderslice whistled one of the movements from a Tchaikovsky symphony, and, oh the chap with the conical head, [Dwight] Marfield, tap danced and sang "Saint Louis Blues".

Walker: I remember it vaguely. I remember very well Vanderslice could whistle all those symphonies.

Tucker: And Henry Whitehead sang some bawdy music-hall ballads.

Walker: No, I don't remember that.

Tucker: It was arranged one evening after dinner. It was to be some sort of a contest to see who could be the most popular entertainer. And when Vanderslice was whistling, he insisted that the lights had to be turned out.

Walker: I don't remember that.

Tucker: That was in the following year, when we were in the common room of Fine Hall.

Aspray: You're one of the few people that can tell us about the differences that the new building made, since you were there before and after.

Walker: Well, it was a completely new world, I can tell you that. Here we were, sort of shoved off in odds and ends of rooms in the physics building. Then all at once we had this mathematical Eden opened up to us, with its wonderful lounge with those deep leather chairs. I don't know that I've ever sat in an armchair as nice as the ones that we had there. And our own library with alcoves that we shared. I shared one with Jacobson all the time I was there. And the carved wooden paneling, and the Professors' Lounge that we were never allowed to go into, and the shower bath that we were never allowed to use. It was just heaven, you know. Oh, and "Bunny" up in the library.

Tucker: Bunny Shields.

Walker: Yes, it was simply wonderful. I've never been in any mathematics building that would come anywhere near to what that was. There were acres of space, you know. Did you get a private office right away, Al, or did you have to wait until you got your degree?

Tucker: It wasn't until I'd been off on my National Research Council Fellowship and come back in the fall of 1933, and then I got to share an office with Jimmy McShane.

Walker: But offices for people that low down, you just don't have that sort of thing anymore. I don't know what it's like in the new Fine Hall, but from what I saw of it, it's too formal, it's too stiff, it's too official. You have to take an elevator to get from one place to another.

Tucker: You're right.

Walker: In the old Fine Hall, you just walked down the corridor.

Tucker: That's right.

Walker: You could see anybody at any time. At the teas in the common room every afternoon. Student and faculty were all there mixing together. Everybody knew everybody else very well. There's just nothing like it really. And the library was just wonderful to go through. I remember hunting through it. Incidentally, I take credit in being the one who introduced *go* to Princeton, because one evening I was just browsing through the library and I found this little German book called *Das Gospiel*. I picked it up—it meant nothing to me—and looked at it. It had some very interesting figures in it and some funny terminology, so I took it down and we started to work on it, and that's where the word '*go*' came from as far as Fine Hall was concerned.

Tucker: That's a story I'm very glad to hear. I didn't know that.

Walker: Of course, it turned out that it was well known in other places, particularly out on the West Coast, but this was its introduction at Princeton.

Tucker: Later on a Princeton topologist Ralph Fox actually acquired ranking in *go* in Japan.

Walker: Yes.

Aspray: How did you come to work with Lefschetz?

Walker: Well, I was always interested in geometry. I don't know, it was just sort of natural. If you wanted to do real honest-to-god geometry—that is, not messing around with a lot of symbols the way Al likes to do—in those days what you did was move around with 2-dimensional manifolds and patch things together this, that and the other. That was Lefschetz you see. Alexander was a little stand-offish. He was fine, I imagine, for the more advanced people on the West Coast, but this was topology's introduction at Princeton. He wasn't too good with the beginners.

Tucker: How did it come to be algebraic geometry rather than analysis situs? As far as I know, you're the only person who did a Ph.D. with Lefschetz in his old field of algebraic geometry.

Walker: I don't really know Al. He was interested in algebraic geometry all along.

Tucker: Oh, of course.

Walker: I guess he simply got me to read some things. I remember he gave me some of the classic Italian stuff to look at. He had this idea, a rather vague idea, about how to get at the reduction of singularities on surfaces, and I think he wanted somebody to work on that. He pushed me in that direction. I really can't give you a good answer to that.

Tucker: I was away, of course, in the year '32-'33, and I suppose that was about the time that you were getting started on your thesis?

Walker: Yes, that would have been the time. Lefschetz probably started me on that in the fall of '32. I know I was well underway at the time we went out to Chicago in the summer of '33.

Tucker: That's right. Do you remember anything particular about that year, '32-'33? There must have been a lot of behind-the-scenes things due to the imminent starting of the School of Mathematics at the Institute and the fact that some professors of the University were going to the Institute and some were not. Do you recall anything of that?

Walker: I'm afraid I don't, Al. I never got much involved in the gossip about things. I sort of lived in my own world. I never knew what was going on among the faculty. I remember Jacobson always used to know so much more than I did about it.

Tucker: As far as you were concerned, there was nothing special about that year?

Walker: The only thing special about that year as far as I was concerned was that I had the fancy fellowship, the Procter Fellowship. I lived over in the Graduate College with Al Sherman, who also had the Procter Fellowship (in chemistry), and worked on mathematics. That was about it.

Aspray: Did you notice any difference after Alexander and von Neumann and company had moved over to the Institute?

Walker: No, I didn't. They didn't have the building then; they were still in Fine Hall.

Aspray: That's right.

Walker: So there was no move, you see. These people were still around, I suppose. I never thought of it particularly. They were getting paid by some other organization, but they still had their offices in Fine Hall. The only thing I noticed was that Fine Hall began to get more crowded. There were fewer offices for the lower-level people.

Tucker: Did you get to know Hermann Weyl?

Walker: Oh, not to know him really. Of course, Hermann Weyl was "the one, the great, the holy Hermann". I took a course under him, I think, or maybe just some lectures. I'm not sure. I don't think I really took a whole course. The only thing approaching physics that I took was a relativity course under Robertson. But of course we all went to lectures and talked in the afternoon colloquiums. Weyl was around and everybody knew about him. But, no, I didn't get to know him personally.

Aspray: Did you talk much geometry with Veblen?

Walker: No. I did not. You see, Veblen had pretty much dropped topology by that time. He was doing differential geometry, non-Riemannian stuff, geometry of paths and that sort of thing.

Tucker: Spinors.

Walker: Spinors, yes. I was never much interested in that sort of stuff. I stuck to Lefschetz and the topology and the algebraic geometry. While I took courses in the other stuff I never did really tie into it very much.

Tucker: Did you have any courses with Bohnenblust?

Walker: I don't think so.

Aspray: Did you study analysis at all?

Walker: Well, the routine things. Didn't Harald Bohr give a course?

Tucker: He did, on almost-periodic functions.

Walker: Almost-periodic functions, that's right. I took that. I took the standard real-variable and complex-variable, both under Hille. Then this almost-periodic functions with Bohr. I don't know that I took any more analysis beyond that.

Tucker: Do you remember Bohr's style of lecturing?

Walker: Oh yes.

Tucker: With chalk and cigar, both.

Walker: Wasn't it Bohr who used to write the whole lecture on the blackboard?

Tucker: Yes.

Walker: He would start at the upper left corner at the beginning of the hour, and he would end with the lower right corner right smack at the end of the hour. I think all the related things would be underlined in different colors.

Tucker: That's right.

Walker: You could follow the trend through just by following the individual colors. And always with that cigar.

Tucker: And you remember Alexandroff?

Walker: Oh, yes indeed. I was a little too untrained at that time to appreciate his course much. You see, that was my first year. My most vivid impression of Alexandroff, other than his rubbing his head ... oh no, two impressions. One is of him reading a book. He had those thick spectacles on, and his spectacles were about three inches away from the print. His eyesight was very bad. And the other was of one afternoon when Bill Randels and I were canoeing up Stony Brook. There on the bank was Alexandroff with one of these very abbreviated European bathing suits on—you know, a jockstrap and that's about all—sunbathing on the bank.

Aspray: Can you tell me something about your being appointed as an instructor? How did it come about?

Walker: Let's see. I don't know that there was too much there. I got my degree in '34, and there were practically no jobs available at that time. Lefschetz wanted to work with me on, what was it, something to do with Morse's calculus of variations in the large.

Tucker: Singular homology theory, wasn't it?

Walker: He had some ideas and he wanted me to stay around for a while. So I was sort of half lecturer and half Lefschetz's assistant that

next year, '34-'35. I did a little bit with what he wanted on the theory, but I don't think anything ever came of it.

Aspray: Did you go to Cornell at the same time that Barkley Rosser did?

Walker: I was a year before. There was a period there when Cornell was becoming Princetonized. Bill Flexner went there in 1934. Then in 1935 Dan Lewis and I went to Cornell. In 1936 Rosser went, in 1937 James Givens went, and in 1938 [Fred] Ficken went. So that in the course of about four years, six people went from Princeton to Cornell.

Aspray: How did that influx of Princeton people affect the development of the Cornell mathematics program?

Walker: Well, I don't know whether it was so much the Princeton connection. Actually at the time Rosser came—that is the year after I came—they got three more people, Saunders MacLane and Lorne MacDonald and John Curtiss. So they had a great influx of young people.

What had happened at Cornell was that the department under [Virgil] Snyder, who was getting very old, had gotten very much in-grown. Some of the younger people in the department were very dissatisfied, and the Dean of the Arts College finally said, "Now look, you've got to get some new people in." So they went out and made a big play to get a whole bunch of young people. Of course that changed the whole situation up there. It just so happened the first year I was there, '35-'36, two of the older faculty members died, and then Snyder retired about a year later. So the whole place was sort of rebuilt. It's hard to know just what the Princeton influence was, except for the inauguration of teas in the afternoon. We didn't have them every day; we only had them once a week before the weekly colloquium. As far as I know that's the only truly Princetonian trait that was brought up by this group of Princetonians.

Tucker: Do you have any recollections of the coming of Einstein to Princeton?

Walker: Not too much. Of course there was a great furor all over Princeton. I do remember that the campus, at least the outside of Fine Hall, was overrun with news photographers and that they had to smuggle Einstein in and out that lower back door, away from them. But that's about all that I can remember. When would that have been Al? In '33?

Tucker: Probably would have been in the fall of '33.

Walker: The fall of '33, yes.

Tucker: Do you remember attending the dedication ceremony of Fine Hall in the fall of '31?

Walker: Only vaguely. I don't recall any details of it at all. I know there was a dedication, and I know I was there. That's about all.

Tucker: Do you remember the lectures that were given by R.L. Moore in Fine Hall?

Walker: Yes, I remember Lefschetz holding himself in all the time that Moore was there.

Tucker: And do you remember that Moore insisted on giving the first of his series of lectures on a Saturday evening?

Walker: No, I don't remember that.

Tucker: Well, he was trying to be disagreeable I guess. He insisted on having his first lecture Saturday night. Lefschetz and Alexander went around and told all the graduate students that they were to be there or else.

Walker: I remember Emmy Noether's lectures very well.

Tucker: Yes.

Walker: They were outstanding. She had a wet sponge, and whenever she wanted to clear the blackboard she would wipe it with this wet sponge. Of course when she wrote over that, it was completely invisible. One time some little drips of water came down from the sponge and got in the way of something she was writing, and so she just blew the water off. She was really a card.

Aspray: Do you remember the parties that were given by the various Princeton faculty in those days?

Walker: Not too well. I remember one, I think it must have been at the Eisenharts', where I first encountered ginger ale of all things. I had never had ginger ale before. I didn't know whether I liked it or not. But no, I don't remember much. I was not a party-goer, you know, Al.

Tucker: Well neither was I. But I used to hear things about parties that almost sounded like wild parties that were given by the Robertsons and the Alexanders and the von Neumanns.

Walker: The Alexander ones were, yes. I heard repercussions of those, but, no, I never went to anything like that.

Aspray: Do you have any anecdotes of people at the time you could share with us?

Walker: I can think of one thing that will give you somewhat of an impression that I got of one person, whom I didn't know very well. And P.A.M. Dirac was there, I don't know whether he was visiting mathematics or physics. He spent an awful lot of time in the common

room, and he introduced a game that you played on the chess board. I think he made it up just about at that time. I never heard of it anyplace else. One side started with eight pawns on the first rank, and the other man had simply a rook on his first rank. The idea was for the man with the pawns, using standard pawn moves, to screen one of his pawns while the rook tried to prevent this. It sounds like not a very interesting game. But the point is this. That every time Dirac played that game, he won it, whether he used the pawns or whether he used the rooks. I don't know of anybody that ever beat him. He was just fiendishly clever at the way he could manipulate those pawns. And then when we'd try, we'd try to do the same things that he did but we couldn't succeed. That's part of it. Another thing about Dirac. Of course we played all sorts of card games, lots of solitaire games. There was a game of solitaire in which you lay out all 52 cards in four rows and then you have to move them around according to certain rules to get the four suits out in order. Well, it's extremely difficult to do this. You almost never succeed. And the supposition was that with the more or less random distribution it was impossible. Well, Dirac one time laid out the cards and started to play the game, and he took notes. He recorded every move he made, and then when he would leave the game he'd record the position so he could start it over again later on. I think he kept this up for a couple of weeks and he got it out. Well, those two little things impressed me with Dirac. I think as being a real brain, a person who could do complicated things in his head and calmly work out the consequences of complicated situations. I could understand some of his contributions to physics a little better after having seen the way he operated in the common room.

Tucker: At one time I think you were interested in magic squares.

Walker: That was later. That was with Rosser at Cornell. Oh, I wasn't particularly interested in magic squares. I mean, I knew what they were and so on, but at Princeton, no.

Tucker: I happened to read in the *American Men of Science* that came out around 1944 that your two specialties were singularities of algebraic manifolds and magic squares.

Walker: Well, it was just before that time. I think it was in '39 that I wrote the things with Rosser. And do you know you write something like that and every nut in the world starts to write to you. I don't know why I put that in there really. I guess it was just because I was getting a lot of letters and then there was at that time, about that time, I was running a column in the *Monthly* and they were always getting little articles about magic squares. Also whenever anything on magic squares came up in the reviews, they would be sent to me.

Tucker: I see.

Walker: So I guess it was on account of that that I put the thing in there.

Tucker: Well, was there any connection between your interest in magic squares and your interest in change ringing?

Walker: No. None whatever. They're completely independent.

Tucker: I have told Bill the story.

Walker: About the change ringer.

Tucker: It started with me lending you *The Nine Taylors* to read when you were in the infirmary.

Walker: Yes.

Tucker: And then how you experimented with the Methodist Church bells.

Walker: Well, no that goes back. Really, that was due partly to Jack Kiefer. Did you know Jack Kiefer at all?

Tucker: Oh yes.

Walker: He and I were the ones that did it together. He was as much into it as I was, maybe even more so. But we just got this idea of trying to do the thing, and he latched onto this electrical engineer who was looking for a senior project. He's the guy that really built the change ringer.