ALBERT TUCKER

THE MATHEMATICS COMMUNITY AT PRINCETON BEFORE 1930

This is an interview with Albert Tucker in his office at Princeton University on 10 April 1984 conducted by William Aspray of the Babbage Institute. This session deals with the Princeton mathematical community in the period before 1930.

Aspray: Professor Tucker would you begin by telling us something about the American mathematics community as it developed in the late-19th and early-20th centuries, prior to the '30s.

Tucker: Well, before 1900 there were really only three places in the United States where graduate education in mathematics, to the doctorate level, took place. The first of these chronologically was Johns Hopkins University, and the other two were the University of Chicago, which was founded as a graduate institution about 1890, and Clark University in Worchester, Massachusetts, which at that time was also a graduate institution. Nowadays it is an undergraduate institution, quite different from what it was in those days. In the 19th century most of the leading mathematicians in the United States got their doctor's degrees abroad, especially in Germany. In a certain sense the Ph.D. system as we now know it evolved in Germany and then was copied elsewhere. The important figure in Princeton mathematical history is Henry Burchard Fine. He studied in Germany with Felix Klein and Leopold Kronecker. He studied at two or three different German universities.

Aspray: This was roughly when?

Tucker: About 1885. The first Ph.D. that was given in mathematics at Princeton was given in about 1900.

Aspray: Do you remember who this was to?

Tucker: I believe it was Henry Norris Russell, who had a distinguished career in astronomy at Princeton.

Aspray: How regularly were Ph.D.s granted then, in this period between 1900 and 1930?

Tucker: Oh, about every other year in the first decade of the 20th century and then more frequently except for the period of World War I. A distinguished mathematician by the name of Robert Carmichael took a Princeton Ph.D. with Oswald Veblen along about 1910, and James Waddell Alexander, the Princeton topologist, took a degree about 1915, not with Veblen as most people think, but with a Swedish-American mathematician by the name of Gronwall, T.H. Gronwall. There is an amusing story that goes with that. Alexander had already published one or two papers with Veblen, basic papers in analysis situs. Veblen advised Alexander that he ought to do his Ph.D. thesis in a more canonical field, that perhaps analysis situs was just a passing fad. So the thesis was actually done in complex variables, an examination of univalent functions. It was one of the first papers on the subject of univalent functions. Then in the '20s there were probably one or two Ph.D.s each year, about half of them were Ph.D.s of Veblen, and the others were mainly Ph.D.s of Luther Eisenhart. Veblen had come to Princeton from the University of Chicago in 1905, as one of the preceptors of the system that was inaugurated by Woodrow Wilson, president of Princeton at that time, in an effort to upgrade the undergraduate education at Princeton.

Aspray: Specifically the undergraduate education?

Tucker: Yes. The graduate education at Princeton has really always been an appendage. The main business has been undergraduate education.

Aspray: Was it really Fine's doing that Princeton developed such a good mathematics department in the early years?

Tucker: Yes, Fine was an excellent mathematician, but not a research mathematician. He had an uncanny knack for spotting mathematical talent. The preceptor system—and he happened to have been a very close friend of President Wilson and a keen supporter of the upgrading of undergraduate education at Princeton—gave Fine an opportunity to bring in promising young mathematicians. Two of these who were brought here from the University of Chicago and served as preceptors were Gilbert Ames Bliss, who later became the leader of mathematics at Chicago, and Oswald Veblen, who became leader of mathematics at Princeton. Others were George David Birkhoff, who became the leader at Harvard, and John Wesley Young, who moved to Dartmouth. Not very often mentioned is the fact that Robert Lee Moore, the famous point-set topologist of the University of Texas, was here for a year or two in the first decade of the 20th century. And from England, Sir James Jeans was brought here as a professor in mathematical physics.

It was in some sense Jeans who established the tradition in mathematical physics, a joint thing between mathematics and physics departments that has persisted through the years. Another famous physicist who was here at that time was Owen Richardson, who was later head of the Physical Laboratory at the University of London. Indeed Oswald Veblen married Richardon's sister.

Aspray: May we go back for a moment to the preceptor system? This was introduced by Wilson in 1905, is that correct?

Tucker: Yes.

Aspray: Could you describe what this system was and what kind of bearing it had on mathematical opportunities?

Tucker: Up until that time at Princeton the lecture system had been used. In a given course there would be a set of lectures. Perhaps there would be 200 students in the course, and their only contact with the professor or with the faculty was through the lecture.

Aspray: I see.

Tucker: The idea of the preceptor system was to have small discussion groups of eight or ten students. The students would prepare papers and discuss them in the precepts, so that it was a much more intimate form of teaching. It was designed to imitate things that went on at the British universities.

Aspray: I see.

Tucker: Now, in mathematics it was found that this system didn't work very well for the elementary courses, that they should still be taught pretty much in a one-way form, but in small classes of about 20. When I came to Princeton and was a part-time instructor in 1929, I taught two of these 20-student sections. It would be in the same course, so I would teach the same thing in both sections.

There might be a dozen or even twenty sections in a course with a professor who was in charge and who taught a hand-picked section of students. The rest of the teaching was done by the instructors. However, to counterbalance this, the lack of one-to-one learning that was supposed to occur in the precepts, the mathematics department set up a system of help sessions that was known by the students as the Missouri Club. This name was given to it because the students came with a "show-me" attitude.

Aspray: I see.

Tucker: One or two young mathematicians were on duty each night in the week, Monday through Friday, for from 7:00 to 10:00 in a certain room in McCosh Hall. This was a large room with blackboards on three sides of the room. The standard practice was that a student would come in, usually to get help doing homework problems, and the

instructor would tell the student to go take a section of the board and try working his assignment on the board. Then the instructor would circulate around the room giving attention for a minute or two to each student. It was something that worked very well, but depending a great deal on the personality of the instructor.

Aspray: Now the impact that this had on the growth of a research faculty at the university was mainly that it provided more positions, is that correct?

Tucker: That's right.

Aspray: Presumably these had to be positions at a fairly low level. The school couldn't afford to hire a large number of senior people, even if they were available.

Tucker: That's right. I suppose that was a principal reason why such people as Birkhoff and Bliss and Moore went on to positions elsewhere. There were only a few senior positions, and those were filled.

Aspray: One might say then that Fine's achievement was making a virtue out of a necessity.

Tucker: Yes.

Aspray: Why don't you give me a list of some of this young, fairly undiscovered talent that Fine cultivated here. You've mentioned some, but I'd like to get a fairly complete listing.

Tucker: Well, I really hesitate to speak about it in the second decade of the 20th century. I've already mentioned it as far as the first decade was concerned. But in the third decade there were quite a few of these. One person who comes to mind is Harold Hotelling, who became famous afterwards as a statistician. He became the head of a very strong statistical group at the University of North Carolina. Hotelling, on graduating from Stanford University, applied to come to Princeton as a graduate student because he wanted to work, he thought at that time, in theoretical economics. And he confused Oswald Veblen with his uncle Thorstein Veblen. He came to Princeton to study with Thorstein Veblen, and it wasn't until he got here that he discovered that he was going to study with Oswald Veblen. He's told me this story himself, so I can vouch for it. He told me that when he discovered his mistake he decided to make the best of it, when in Rome do as the Romans do. So he did a Ph.D. in topology, or analysis situs as it was called at that time, on three-dimensional manifolds. That was his first published paper. He didn't publish anything more in topology, although he did publish one paper—it was just a note really—in which he related something from analysis situs to something in statistics.

Aspray: I see.

Tucker: Then others at that time who were developed here were Alonzo Church, who was a Princeton undergraduate who caught the eye of Veblen. Veblen encouraged him to go on here as a graduate student and supervised Church's thesis, even though the thesis was in logic rather than geometry. Then Church had a post-doctoral fellowship for a year or two. He did spend some time in Amsterdam, but then returned to Princeton and was at Princeton until he retired and moved to UCLA. Others developed at that time were Morris Knebelman, who came to Princeton from Lehigh when he was already about forty years of age. He worked with Veblen and Eisenhart in differential geometry, as did the two Thomases, T.Y. Thomas and J.M. Thomas. Also there was Paul Smith, the Columbia topologist, a Lefschetz Ph.D.

Aspray: The Thomases weren't related, were they?

Tucker: Not as far as I know. T.Y. Thomas stayed on and was a member of the faculty at Princeton until he left in 1938 to go to UCLA. J.M. Thomas was here through post-doctoral years and then went to Duke University. He may have been at the University of Pennsylvania first and then Duke, I'm not sure.

Aspray: Did any of his colleagues or his students ever ask Fine what constituted this talent of being able to see promising young mathematicians?

Tucker: No, I have no information at all on that. Fine, of course, was very heavily involved in university administration. He had been Dean of the Faculty under Woodrow Wilson. After that he was made Dean of Science, and he was chairman of the mathematics department from the time that the department was organized. There weren't departments until during Woodrow Wilson's presidency, but he was chairman of the mathematics department from then until he died in 1928. He was also the chairman of the university research fund. So in all sorts of ways besides mathematics he was an outstanding figure at Princeton University. In mathematics he was one of the founders of the American Mathematical Society, and he became the president of the American Mathematical Society. He was responsible for bringing the *Annals of Mathematics* to Princeton around 1911.

Aspray: From the University of Virginia?

Tucker: The *Annals* was started in 1884 at the University of Virginia by Ormond Stone, a professor there. He subsidized it from his own pocket for about ten years, and then the university helped, but finally it was taken over by Harvard University in 1889. It was at Harvard until 1911 with Maxime Bocher and others taking turns editing it. After it came to Princeton there was a certain rotation in the editorship with Fine and Eisenhart and Veblen. But after two or three years the primary responsibility fell in the hands of J.H.M. Wedderburn, who was one of the preceptors brought here by Fine—I think in 1909 in the case of Wedderburn. A Scot, he was brought in from Edinburgh, where he had been trained. As a matter of fact his name as he used it at first was Maclagan-Wedderburn, so that he was Joseph Henry

Maclagan-Wedderburn, but later on he took 'Maclagan' and made it his third first-name.

Aspray: I see. One of the things that you mentioned about Fine was quite important for the development of the mathematics department, namely the research fund.

Tucker: Yes.

Aspray: Would you describe that in more detail?

Tucker: In the first place, people in the University became so accustomed to calling him Dean Fine that after he ceased to be Dean of the Faculty he was made Dean of Science with no particular duties. It was just a nice honor so people could continue to call him Dean. But he felt that he should do something to earn this title, and he felt that the thing that the scientific departments needed most was research capital. With the help of, I think it was, the General Education Board of the Rockefeller Foundation and a campaign to raise funds from Princeton alumni, he put together in the late 1920s a capital sum of $3 million. The income from this was divided five ways, with the mathematics department receiving one-fifth. This was used imaginatively by the mathematics department. Of course other scientific departments had to use it on laboratory equipment and so on.

Aspray: It was a good deal for mathematics.

Tucker: Yes, because the mathematics department was able to use all of its share on people. Well, I guess a bit was used on the library, but almost all was used on people. It was used to bring in distinguished visitors. For example, in the year '27-'28, two now-famous topologists from Europe were brought here: Paul Alexandroff from Moscow and Heinz Hopf from Zurich. This greatly accentuated the topology that was already going on at Princeton, in the hands of Veblen in the first place, Alexander in the second place, and Solomon Lefschetz in the third place. Lefschetz was brought here in 1924 mainly at the instigation of Alexander, because Alexander had been very much impressed by papers that Lefschetz had written. Lefschetz was brought from the University of Kansas as a visiting professor. Then the following year he was appointed associate professor with tenure.

Aspray: Maybe this is a good point in our conversation for you to give me a list of the faculty, both the research faculty and the teaching faculty, as it appeared in the very early 1930s, before the break-off of the Institute.

Tucker: All right. I may forget someone; I really should have had a list prepared. When I was a graduate student—I started in 1929 and got my degree in 1932—the chairman of the department and Dean of the Faculty was Eisenhart. He had become Dean of the Faculty in 1924. I'll take the others alphabetically. This is the list for the academic year 1930-31. James W. Alexander, professor; Alonzo Church,

assistant professor; William Gillespie, professor. (Gillespie had been brought in from the University of Chicago in the 1890s, but he contented himself with teaching underclass courses.) Einar Hille, associate professor. He had come here in the early 1920s from Stockholm. Morris Knebelman, assistant professor; Solomon Lefschetz, professor; Howard P. Robertson, associate professor. We should have mentioned him as one of the people developed here during the 1920s. He took his Ph.D. at Cal Tech and came here on a post-doctoral fellowship. He then was appointed to the faculty. Tracy Y. Thomas, assistant professor. He got his Ph.D. in the '20s with Oswald Veblen. Oswald Veblen, professor; John von Neumann, professor, but on leave during the first term; Joseph H.M. Wedderburn, professor; and Eugene Wigner, professor. Now von Neumann and Wigner shared, at that time, a professorship at Princeton and an appointment in Berlin. One of them would be here for one of the terms, and the other for the other term.

Aspray: I see.

Tucker: They commuted from Berlin to Princeton.

Aspray: At this time did they hold the Jones Professorship?

Tucker: No, it was later that Wigner became Jones Professor.

Aspray: And that was the research position in mathematical physics.

Tucker: That was the research position in mathematical physics, partly regarded as in the physics department. And I should have mentioned that Oswald Veblen had the research professorship in mathematics, the Fine Professorship, which had been established in 1926.

Aspray: Let's see, it was Gillespie and Knebelman who were the two people responsible only for undergraduate education at this time, is that right?

Tucker: Yes. Knebelman handled the engineering courses and mechanics, and Gillespie handled the first course, which in those days was a combination of college algebra and trigonometry.

Aspray: The other people on the staff, did they teach both graduate and undergraduate courses?

Tucker: The senior people, such as Eisenhart and Lefschetz, would teach one graduate course each term and one undergraduate course. Customarily Eisenhart taught a sequence of graduate courses, that ran through two years, in differential geometry, Riemannian geometry, and continuous groups. And Lefschetz did the same sort of thing. Eisenhart's undergraduate course was always a freshman course. As I've come to realize later, he did this to set an example and make it that no one in the department could complain about having to teach freshmen when the chairman of the department was teaching freshmen. The assistant professors didn't very often have the opportunity to teach a graduate course.

The senior faculty, the professors, that is Alexander, Eisenhart, Lefschetz, Veblen, and Wedderburn all taught graduate courses every term. Now, Hille taught a graduate course every term, and this was because he was the only one available to teach real and complex variable. The graduate students for their general examinations all had had to be prepared in real and complex variables, so it was important to have these courses taught on a regular basis. Others of the assistant and associate professors taught, I would say, a graduate course about half the time.

Aspray: We'll come back to education later on, let's try to round out the community. You've mentioned the faculty members. You've mentioned that this research fund that Fine had established which brought in visitors, and you've mentioned a couple of examples of those. I understand there were also some national fellowships.

Tucker: Well, perhaps we might first of all talk about the instructors.

Aspray: All right.

Tucker: In that particular year there were two full-time instructors: they were A.L. Foster and James Singer, who had just taken Ph.D.s with Alexander and Church/Veblen. Then there were seven part-time instructors, as they were called, who taught six hours a week. The senior one of these was W.W. Flexner, the son of Simon Flexner of the Rockefeller Institute and the nephew of Abraham Flexner, the founder of the Institute for Advanced Study. Flexner had just completed his Ph.D. with Lefschetz in what is now called topology.

The other part-time instructors were graduate students also. Bohnenblust, H.F. Bohnenblust who had come here with Hermann Weyl when Hermann Weyl was the first Jones Professor here in '28-'29. He'd come as Weyl's assistant and then stayed on to do his Ph.D. with Hille. Stephen C. Kleene, a student of logic. Jack Levine, who did his Ph.D. in 1934 with T.Y. Thomas, I think, and who is a retired professor at North Carolina State University in Raleigh. F.H. Sillick, Jr. Sillick didn't finish his graduate studies. I don't know what has happened to him. Edwin Warren Titt, who was a very close friend of mine. We both came in 1929 as graduate students. He came from the University of Kansas and took his Ph.D. the same year I did, 1932, with Tracy Thomas. And then the last of these is myself, A.W. Tucker. These part-time instructors taught six hours a week in freshman-sophomore courses.

Another category of graduate students were the research assistants. These assistantships were made possible by the scientific research fund. Research assistants received modest stipends and free tuition to do odd jobs for senior professors in the department, perhaps grade papers for them, do bibliographic work. Occasionally they were pressed into service for Missouri Club duty. The title research assistant was simply to justify paying them out of research funds, but they were carefully chosen as people who later on would become research mathematicians. In the year 1930-31 the list is Nathan

Jacobson, L.S. Kennison, who later taught at Dartmouth and then was in the Navy during the war. He was involved in naval communications, and I think he stayed in as a naval officer. Taai Han Kiang, a Chinese student, who was here from mainland China. At that time Princeton was affiliated with a university in Peking, a Chinese university, not a national university but a private university there. Because of Princeton's Presbyterian background they had a certain missionary connection. William Randels, who switched from Princeton, took his Ph.D. at Brown, and went into industry. I think he is now working somewhere, unless he is retired, out in the Silicon Valley. Harry W. Smith, I don't remember who he was. And Banesh Hoffmann, who became an assistant of Einstein and has a fine reputation in mathematical physics, particularly the field of relativity. And Frank Cubello, someone I knew who came from Niagara Falls, but he dropped out after getting his masters degree to work as a actuary. Then there were post-doctoral research fellows attached to the department.

Aspray: Did these people come on the department research funds or on outside funds?

Tucker: The Americans came on so-called National Research Council Fellowships. At that time, in any one year there would be perhaps 30 young Americans who had these stipends.

Aspray: 30 within mathematics?

Tucker: 30 within mathematics. There were other fields too, and certainly there would be more in physics than in mathematics. The best of the American Ph.D.s at that time usually followed their Ph.D. with National Research Council Fellowship of one, or two, or even three years. A very well known American mathematician who took his Ph.D. at the University of Chicago and had been around Princeton during the earlier period that we were talking about was A.A. Albert.

Aspray: Oh, yes.

Tucker: He held a National Research Council Fellowship for three years, I think, and two of those years he spent around Princeton. He got ideas for much of his early work here. His work on Riemann matrices was stimulated by contacts with Lefschetz, and at the same time he did things that had to do with algebra relating to quantum theory because of contacts with von Neumann and Wigner.

Aspray: Would you tell me why people came to Princeton on these National Research Council Fellowships?

Tucker: Well, the great advantage that Princeton had over other leading places in mathematics, I think, was a matter of the pleasant living conditions that there were in Princeton. At that time Princeton was still a small town with a population in the borough, excluding students, of somewhere around 2000. For a single fellow it was quite possible to get a room within easy walking distance of the campus and town. There were restaurants on the main street, Nassau Street,

opposite the campus, and good library facilities. There wasn't office space at that time, but I guess that wasn't expected anywhere. But the living was very comfortable and peaceful as contrasted with the University of Chicago, in the heart of a large city, or Harvard, in an urban area, or Columbia or Pennsylvania. At that time people didn't think of going to Stanford, but among the places that were regarded as top places, Princeton was the one that provided comfortable living conditions.

Aspray: I interrupted you from sort of charting out the rest of this. The foreign visitors, the foreign post-docs, where did their funds come from?

Tucker: At that time, there were also the International Research Fellowships. So-called. They were really funded by the Rockefeller Foundation and handled by some board in Washington, perhaps at the National Academy of the Sciences or something like that. These were designed to permit Americans to go abroad and conversely to bring people from Great Britain and the Continent to the United States.

Aspray: So a large number of these people were on that support?

Tucker: At that time we would usually have two or three. These funds started to run out towards the end of the '30s, and they were gone about the time of World War II. But the peak was the late '20s and the early '30s.

Then Princeton itself had some fellowships called the Procter Fellowships, fellowships that were given to the university I think by the Procter family of Procter & Gamble, Cincinnati. And there were about ten of these given by Princeton to its own students, and then there were three Procter Visiting Fellowships given each year to foreigners, one on nomination of Cambridge, one on the nomination of Oxford, and one on the nomination of Paris.

Aspray: I see.

Tucker: And very often all three of these were in mathematics, although they were supposed to be for all fields. Another source of fellowship funds was the Commonwealth Fellowships. I'm not quite sure about these, but there was something called, I think, the Commonwealth Fund, and these Commonwealth Fellowships were to bring people from the United Kingdom to the United States. So for this time that we are talking about, 1930-31, such a Commonwealth Fellow, who was here working with Veblen, was J.H.C. Whitehead, the man who became very famous later as the leading British topologist. He was a nephew of A.N. Whitehead, of *Principia* fame.

Now I see in the list for 1930-31 the following were National Research Fellows here. Benedict Cassen; I think he was in mathematical physics. Then Leon W. Cohen, who was here to work with Alexander and Lefschetz. He was a point-set topologist, a Ph.D. of R.L. Wilder at the University of Michigan. He was advised by Wilder

to come to Princeton to broaden his perspective in topology. And he has had a very fruitful career. Another was Neal McCoy, algebraist. I think he took his Ph.D. at the University of Wisconsin with C. C. MacDuffee, who had been at one time a fairly close student of Wedderburn. I think it was MacDuffee's recommendation that McCoy came to Princeton for his post-doctoral. McCoy later on became a mathematician at Smith College. Then Edward A. Linfoot, an Englishman, I think on a Procter Visiting Fellowship. He, as I recall, worked in analysis. Also Thomas S. Graham, a Glascow Scot, in differential geometry.

Another National Research Fellow who was here at that time, Edward James McShane, who was perhaps the most distinguished Ph.D. of Bliss at the University of Chicago in the field of calculus of variations. I remember him particularly well because at that time he claimed that he worked best on a 26-hour day. The result was that if one day he got up at 10:00 AM, then the next day he would get up at noon, and the next day at 2:00 PM, and so on. He only broke this when there was a seminar that he felt that he just could not miss. At that time there was a restaurant on Nassau Street, the Baltimore Dairy Lunch, that kept open 24 hours a day. So he could go there and get meals any time. There were rooms for mathematics in the Palmer Physical Laboratory; they were called the mathematics seminary, but this was a name for the mathematics library. The mathematicians would receive keys to the laboratory so that they could get in at any time. The laboratory would be locked up at 6:00 in the evening and not open up until 8:00 in the morning, but if you had a key you could get in any time you pleased. So he could work in the library any time he pleased and get his meals any time he pleased. So except for such fixed engagements as seminars, he could observe a 26 hour day.

Aspray: I see.

Tucker: Later on, he returned to Princeton as an assistant professor. By that time he was married, and he worked on a 24 hour day. I think this is the list of the research fellows. These were all people who had Ph.D.s from somewhere. With the National Research Council Fellowships you were supposed to go to a different place. You would only be given permission to stay at the university where you had got your Ph.D. if there was some research effort going on that had to continue.

Aspray: I see.

Tucker: Let's see, there were eight instructors (2 full-, 6 part-time), and it happens there were seven research assistants that we named. Then there were about six or seven of these post-doctoral fellows.

Of the graduate students in the department I find the following that I haven't mentioned: J.L. Barnes, scholar; Banesh Hoffman, research associate (to Veblen); J.L. Vanderslice, fellow; R.J. Walker, fellow. These four went on to university careers, but there were five others who dropped out without Ph.D.s: Basye, Cubello, Dahnken, Sillick, and H.W. Smith.

Aspray: Now is this the entire group of people that comprised the Princeton mathematics community at the time?

Tucker: That's right.

Aspray: I assume there would be short-term visitors coming in and out, but there's no other major category of long-term visitors.

Tucker: Yes. Of course, 1930-31 is just before things started to pick up with the Institute for Advanced Study coming. In a way that year '30-'31 should be regarded as the end of the previous decade rather than the start of the next. It was in the fall of 1931 that Fine Hall was opened. In '30-'31, the year we are talking about here, Fine Hall was being constructed.

Aspray: Would you tell me the story of the Jones family and the construction of Fine Hall?

Tucker: All right. Eckhart Hall at the University of Chicago was built for mathematics in the 1920s. It was particularly Veblen, who had come originally from Chicago and had strong ties with Chicago, that wanted to have something like Eckhart Hall at Princeton. So he worked on Dean Fine to have this as a goal in connection with the Scientific Research Fund. This was resisted at that time on the grounds that this couldn't be done for all of the scientific departments. Of course physics had its laboratory, and chemistry had its, but they felt that they needed enlarged accomodations, and psychology in particular did not have suitable accomodations, nor did astronomy have very good accomodations. So although there was this desire to have a building for mathematics, there didn't seem to be the possibility until the death of Dean Fine, which occurred at the very end of 1928, in the week before Christmas.

In Chicago there were two wealthy brothers, Princeton class of 1876, Thomas D. and David B. Jones. They were not the same year as Fine, but four years earlier, and they had been very strong in their support of Princeton. By the way, at the time that they graduated from Princeton it was called the College of New Jersey. It did not become Princeton University until 1896 at the 150th anniversary of the founding of the College of New Jersey. The Jones brothers had become trustees of Princeton University and had made gifts to the University for library facilities and other things. In 1926 Thomas D. Jones set up the Henry Burchard Fine Professorship of Mathematics, the research professorship in mathematics, first held by Veblen.

Aspray: This was in connection with Fine's push for the Scientific Research Fund?

Tucker: This was actually done independently of that and occurred at the beginning of Fine's fund raising. It was never too clear as to whether that was part of the $3 million, but it was certainly part of the overall effort. And they set up other professorships, the professorship in mathematical physics is the Thomas D. Jones Professorship, and the

research professorship in chemistry is the David B. Jones Professorship, founded by Miss Gwethalyn Jones in honor of her father. That was the professorship that Hugh Stott Taylor occupied so brilliantly for many years. So Princeton had benefitted very greatly from the Jones' gifts.

Within a few weeks of the death of Dean Fine, Thomas D. Jones and his niece Gwethalyn Jones offered to give, in honor of Fine, the building that the mathematics department, particularly Veblen, wanted. It was, as near as was legally possible, a gift to the department of mathematics because the deed of gift stipulated that the use of the building should be determined by the department of mathematics. Besides paying for the building itself, which as I recall was something like $375,000, they set up a fund for the maintenance of the building.

The building was very lavishly furnished with leaded-glass windows. Many of the offices, or studies as they were called, were oak-paneled throughout, with fireplaces, and filing cabinets concealed behind the paneling, and coat closets behind the paneling, and a blackboard that would open up, which when it was closed was panelling. There were rugs on the floors and easy chairs, and a couch in each of the major offices with the idea that Professor Veblen or Professor Alexander could take a siesta after lunch. Our present Fine Hall is very spartan compared to the original Fine Hall. There was a beautiful library on the third floor.

The support from the Jones family to Princeton, to in particular the mathematics department, was most remarkable. And, I think, the building which opened in 1931 had a great deal to do with the attractiveness of Princeton as a place for young mathematicians to come on their fellowships. I should have said that the deed of gift also specified very definitely that the professors in mathematical physics should have studies in Fine Hall. So von Neumann and Wigner, the ones that who here when Fine Hall was built, were given studies in Fine Hall and in the adjoining physics building, Palmer.

Aspray: The other major event of that time was the founding of the Institute for Advanced Study. Would you like to make a few comments about it sort of as a termination of our discussion of the pre-1930s period?

Tucker: The Institute for Advanced Study was the concept of Abraham Flexner. He had done studies with foundation support on medical schools and on higher education in general. These reports had great effects. Medical education was almost completely revised and revitalized as a result of the report on medical schools, which came out about 1910. Incidentally, this report said that there were then only three or four respectable medical schools in North America, and two of these were McGill and Toronto. This gave me great pride as a young Canadian.

The report on higher education appeared in 1930. It emphasized that in leading universities there should be research conducted for its

own sake, not for degrees but just for the advancement of knowledge. Families in Newark, New Jersey, the Bamberger family of Bamberger's department stores and the Fuld family, related to the Bambergers, had got to know Abraham Flexner and heard from him directly about some of his dreams for higher education in the United States, or really North America.

They decided that they would endow an institute, unnamed at that time, and that this institute should be planned by Abraham Flexner. The one stipulation that they made was that it should be located in New Jersey, their home state, or in contiguous territory, which would have allowed it to have been, for example, in New York City or in Philadelphia. Flexner decided on Princeton, because he felt that the rural atmosphere which Princeton provided was more appropriate than a city atmosphere. There already was the Rockefeller Institute for Medical Research that was partly in New York City and partly in Princeton. What is now the Forrestal Campus of the University was then the division of the Rockefeller Institute for Medical Research that dealt with animal and plant pathology.

Aspray: I see.

Tucker: They could have their greenhouses, pens, and so on very comfortably there. Because of his brother Simon Flexner being the director of the Rockfeller Foundation for Medical Research I'm sure the suggestion of Princeton came up quickly. There were two important things about Princeton: there was the rural atmosphere and there was a library. You can't start a research institution without having a library, and it's pretty hard to build a library suddenly from scratch. That's something that has to be done over many years. So it was decided to locate the institute in Princeton, and it was actually legally incorporated in the State of New Jersey in the year 1930. So the date of its founding is 1930, but no appointments were made until 1932.

Flexner travelled all over the world in the years '30-'32, and everywhere he went he would ask leading scholars: "Who do you regard as the leading people in your field?" And the only field in which he got fair unanimity, wherever he asked the question, was mathematics. Also mathematics did not require laboratory facilities, so Flexner decided to make a start on mathematics. He got in touch with Veblen, or was already in touch with Veblen, and with Veblen as his advisor he set up the School of Mathematics. I think at that time it was called the School of Mathematics and Natural Sciences. Because there were no buildings when people arrived in the fall of 1933 to begin as members of the Institute for Advanced Study—as they had been decided to call it—use was made of some surplus space in the new Fine Hall to house the School of Mathematics. At that time the only offices of the Institute for Advanced Study were the Director's office, which was in a business building on Nassau Street, and the offices of members of the School of Mathematics, which was housed in Fine Hall along with the University's mathematics department.

Aspray: Why don't you just tell me who was appointed?

Tucker: The initial appointment, I believe, was Oswald Veblen. He was appointed professor, I think sometime in 1932, and he started receiving a salary in the fall of 1932. Then he, in consulation with Flexner, chose the other professors in mathematics. J.W. Alexander, professor at the University, a lifelong Princetonian. John von Neumann, who was part-time with the University but then was going to be made full-time at the university because, due to Hitler, the Berlin connection had disappeared. He was just on the point of accepting a professorship, the Jones Professorship, in mathematical physics at Princeton University when he was offered a professorship at the Institute. He took the latter, I think with the idea then that this meant that Wigner could get the Jones Professorship, because they'd been sharing it. They were both from Budapest and had been friends from boyhood. I think it was perhaps almost a coin toss as to which one would go which place.

Then Hermann Weyl from Goettingen, and Albert Einstein. I don't know exactly where Einstein was at that time. He was still nominally at Berlin, but because of being a Jew he couldn't safely be there. I think it was only after he had accepted the appointment at the Institute for Advanced Study that the Nazis got around to throwing him out of Berlin. They had hesitated to do this, even though it was a natural for them, because of world opinion. Another appointment was possibly made at that time: Marston Morse from Harvard. But he didn't come, and the others all started functioning in the School of Mathematics in the fall of 1933. Morse didn't come until the fall of 1934. They were the original professors in the School of Mathematics at the Institute, and it wasn't until another ten years or more before there were further appointments to professorships.