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The Princeton Mathematics Community in the 1930s
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ALBERT TUCKER

THE REPUTATION OF PRINCETON MATHEMATICS

This is an interview of Albert Tucker in his home in Princeton, New Jersey on 9 October 1984. The interviewer is William Aspray.

Tucker: For this account of the growth of the reputation of the mathematics department at Princeton, I think a convenient starting point is 1905, when Woodrow Wilson took the lead in starting the preceptor system at Princeton. This meant that in most fields the teaching by large lectures was replaced by the use of small classes in conjunction with the large lectures. In establishing this system, Woodrow Wilson was supported strongly by Henry Burchard Fine, who had been appointed just before that to be Dean of the Faculty. He also had the title of Dean of Science, and was as well the chairman of the mathematics department.

Dean Fine urged that the scientific departments which didn't fit into the preceptor system exactly should have enlarged membership, and Fine was able to attract some very promising mathematicians to Princeton. Eisenhart had been at Princeton since 1900. In 1905 there were three appointments: Oswald Veblen and John Wesley Young as preceptors, and James Jeans, the British mathematical physicist, as professor of mathematical physics. Another one who came at that particular time and stayed only until 1908 was Gilbert Ames Bliss. He later became the long-time chairman of the department of mathematics at the University of Chicago.

Aspray: Yes.

Tucker: When Bliss departed, George David Birkhoff was brought to Princeton. Birkhoff stayed until 1911 when he went to Harvard and

became, of course, the leading mathematician at Harvard. Another person who was brought at that time, well in 1906, and stayed until 1908, was Robert Lee Moore. He became the leader of the school of point-set topology for which the University of Texas has become famous. Also, in 1909, John Henry Maclagan Wedderburn was brought to Princeton and remained at Princeton—except for war service during World War I, when he served as an enlisted man in the British army—until his retirement in 1945 and death shortly after that.

Aspray: Quite a distinguished group.

Tucker: ... who had been selected by Fine. He truly had a talent for it, spotting promising mathematicians. In addition to this talent, he developed over the years a vision of what he thought the Princeton department could become. This vision showed itself in the late '20s when he tried to get funds to endow professorships, research professorships, and to help in various other ways. I think I will just quote from a document that came out on fund raising in 1926. My guess is that it was Dean Fine who prepared the text.

At Goettingen there has always been a large group gathered together which has maintained itself so well that the prestige of the mathematical institute at Goettingen is, if possible, greater now than it has ever been. During the same period of time other German universities, which have depended for their eminence on particular individuals, have had vicissitudes of all kinds. The preeminence of Goettingen now is due to the laws of statistics and the power of tradition. A similar history can be realized by the department of mathematics at Princeton University if the opportunity which has come to Princeton is ensured prompt and full realization.

I think he is referring there to the group that has already been gathered at Princeton.

The means to the full realization of the purposes of the mathematics department are: (1) endowment for research professorships.

I would comment here that the Jones brothers had been lifelong friends of Dean Fine; they graduated from Princeton in 1876 and Dean Fine in 1880. In 1926 the Jones family in Chicago, set up four research professorships: the Henry Buchard Fine Professorship in Mathematics, to which Oswald Veblen was appointed; the Brackett Professorship in Physics; the Thomas D. Jones Professorship in Mathematical Physics, first occupied on a visiting basis by Hermann Weyl; and finally the David B. Jones Professorship in Chemistry. This was done by David and Thomas Jones and Gwethalyn Jones, the daughter of David Jones. At the same time the Jones family contributed also to the endowment for the Scientific Research Fund, which was set up at about the same time, a little bit later.

Aspray: This was the one that Fine was responsible for.

Tucker: Yes. Of course all along Fine had very strong support in his planning from Eisenhart and Veblen. But as I see it, it was Fine who had this vision. The reference to Goettingen is, to me, the key that this was Fine's thinking, because Veblen up to that time had not been abroad very much and his preferred place was in England, Oxford and Cambridge.

Aspray: I see.

Tucker: Eisenhart had not studied abroad. Eisenhart took his doctor's degree at Hopkins and came from that directly to Princeton as an instructor, and he was at Princeton for 45 years until he retired in 1945. So that I don't think that either Veblen or Eisenhart would have prepared this in the way that it is. This, of course, is just circumstantial evidence. I would very much like to know more about it than I do.

Aspray: Your comment here on Goettingen and the other German universities reminds me of the distinction you made in an interview yesterday on the difference between Princeton and places like Harvard or Hopkins, of a whole group of people versus individual faculty members.

Tucker: Fine, you see, had taken his degree at Leipzig, then had been for a while at Goettingen. Indeed he took his Ph.D. with Felix Klein at Goettingen. Then Klein, I'm not sure of the dates, apparently moved. Klein had taken his degree at Leipzig and then, I think, moved to Goettingen. That's something I must check up on. The other German mathematician that Fine had great admiration for was Kronecker.

Aspray: I see, but not particular for David Hilbert.

Tucker: Hilbert was just a coming person at that time. Clearly, it was the dominant figure of Felix Klein that Fine thought most of, but he also thought highly of Kronecker, with whom he formed a friendship. He was very much impressed by Kronecker's rather constructive points of view. In other words, it was Kronecker's point of view that became Fine's point of view when he came back to teach at Princeton.

Aspray: The arithmetization of analysis and that sort of work.

Tucker: Yes.

Aspray: But by 1926, at the time of the writing of this, Hilbert certainly had come into his prominence.

Tucker: Oh yes. I was mentioning these seven needs, of the mathematics department. The first one, "endowment for research professorships", was secured. Second, "improvement and increase of personnel with schedules compatible with better teaching and more research". Three, "a departmental research fund to meet changing conditions". That was achieved as part of the Scientific Research

Fund, which Fine took the lead in getting established. He was, after all, Dean of Science, which was more, from the university's point of view, an honorary title than a responsibility, but I feel like Dean Fine felt he should earn his title. Four, "a visiting professorship which might well bear the name of Boutroux". This was a French mathematician, who was a professor briefly at Princeton in 1913-14. He apparently went back to France because of the outbreak of World War I and did not at any time return to Princeton. He had a distinguished career as a professor in Paris.

Aspray: Why would one want to name a professorship after him?

Tucker: I judge that somehow or other Boutroux had caught the fancy of Fine and others at Princeton. He was made one of the editors of the *Annals of Mathematics* when he came to Princeton in 1913, and he continued to be listed as an editor of the *Annals of Mathematics* until the time that this fund-raising appeal was initiated.

There was another European who had come to Princeton to teach in 1913-14, and that was T.H. Gronwall, who had a remarkable career because he dabbled in many different things. When he was here at Princeton in '13-'14, he was working mainly in functions of a complex variable. Indeed he was the one who supervised the Ph.D. thesis of J.W. Alexander, when Veblen felt that topology might be a passing fad. Gronwall also continued to be listed as an editor of the *Annals of Mathematics*. So it was clear that the department had very good feelings towards both of these men and probably would have been very glad to have had either one of them back.

Five, "a group of offices or other rooms for mathematical work, both undergraduate and advanced". Six, "continued financial support for the *Annals of Mathematics*". Seven, "a number of graduate scholarships". Well, in one way and another, all of these things very soon came about. Immediately after Dean Fine's death at the end of 1928, the Jones family offered funds for a building for mathematics. Things proceeded promptly, and Fine Hall was open for business in the fall of 1931. It provided in very handsome fashion a group of offices and other rooms for mathematical work both graduate and advanced.

Aspray: Did it provide rooms for undergraduates?

Tucker: No, I beg your pardon, it did not. That was later on, after Dean Eisenhart retired in 1945. A room was set up in Fine Hall at that time, called the Eisenhart Room. There was a collection of books there that might be especially useful to mathematics majors.

Aspray: Yes.

Tucker: The undergraduates were not, as a rule, expected to use Fine Hall. The mathematics majors were made welcome to come to tea if they wanted to and to use the library the way the graduate students used them. In order to make a point of attraction for the undergraduate majors one of the corner rooms of the library was set aside as the

Eisenhart Room for undergraduates. Fine, I feel, was the one who paved the way for the great department of mathematics that we had in the 1930s.

Another adjunct to the success of the department was the Graduate College. This residence for graduate students was first built about 1911, and then was added to sometime in the 1920s. The Graduate College had very much the atmosphere of residential life at Oxford and Cambridge. There was a dining hall, where the graduate students wore gowns when they ate dinner. The dining hall, Procter Hall, was used only for dinners, which included Sunday dinner. A less formal place was used for breakfast and lunch. There was definitely the encouragement for people who lived at the Graduate College to socialize together.

At the same time, Princeton had a very good fellowship program, much of which was provided by the Procter family of Cincinnati. In particular each year, each of Oxford, Cambridge, and the University of Paris sent some very promising student, graduate or post-doctoral, to Princeton, and rooms were always reserved at the Graduate College for these Procter Fellows. There were also Procter Fellowships, about ten of them, for Americans.

Aspray: Yes.

Tucker: Usually one of the ten Procter Fellowships would be held by a mathematician. This was usually for a student who had passed his generals and would be finishing his Ph.D. thesis during the year of the fellowship.

Aspray: I see. None was specifically designated for mathematics.

Tucker: No.

Aspray: They were competitive.

Tucker: Yes. For example, I held a Procter Fellowship in the year '31-'32, the year I was finishing my thesis. That, unfortunately, was the only year that I lived at the Graduate College. The previous two years, because I had applied very late in 1929, I couldn't get into the Graduate College, and I found a room in the dormitory at the theological seminary. But when I was appointed to the Procter Fellowship in 1931, this automatically meant that I got a room at the Graduate College. At that time, in the 1920s and early 1930s, there was a quite ambitious post-doctoral fellowship program administered by the National Research Council. So the more promising of those who were getting Ph.D.s were usually appointed, if they applied, to these NRFs, National Research Fellowships.

Aspray: Yes.

Tucker: For various reasons, practically half of these Fellows in mathematics chose Princeton as the place to hold their fellowships.

Aspray: Reasons that were mostly intellectual.

Tucker: Intellectual, but also the fact that it was at that time a nice quiet college town. You didn't have problems to contend with, as you would at Columbia or Chicago, in finding congenial housing and having a pleasant atmosphere in which to live.

Aspray: I see.

Tucker: These fellowship holders sometimes succeeded in getting a room at the Graduate College, but more often they lived in town where, at that time, it was quite easy to get a room near the campus.

Aspray: I see.

Tucker: Of course some of the National Research Fellows were married. That program was, I think, a very successful fellowship program. It is perhaps interesting to note that the committee that made the choices in mathematics consisted of Oswald Veblen, George David Birkhoff, and Gilbert Ames Bliss, all of whom had at one point been colleagues at Princeton. There were other fellowships, such as the International Research Fellowships, which, like the NRFs, were funded by Rockefeller Foundation. For example, in '27-'28, Paul Alexandroff of Moscow and Heinz Hopf of Zurich were here at Princeton as International Research Fellows. Also, there were the Commonwealth Fellowships, which were designed for scholarly interchange between Britain and the United States. Because of the Graduate College and other aspects of Princeton, the people who came from Oxford and Cambridge almost always chose Princeton as the place to come. Already at that time Princeton had won some fame in mathematics. It was especially the Commonwealth Fellows in mathematics who tended to choose Princeton as their place to work.

Aspray: I see.

Tucker: When I came to Princeton as a graduate student in 1929, of the people that I encountered in what I thought of as the student category, distinguished from the faculty, about half of them seemed to be holders of fellowships: National Research Fellows, International Fellows, Commonwealth Fellows, Procter Fellows. One of them, for example, was Henry Whitehead, the nephew of the famous British philosopher. He came to Princeton on a Commonwealth Fellowship just after the time that Veblen had changed places with Hardy in Oxford.

Aspray: So there was very good support for graduate students from a number of different countries as well as the U.S.

Tucker: At the same time some of the mathematics share of the Scientific Research Fund was used each year to pay so-called research assistants. They got rather small stipends, perhaps about \$800 for the year, but a half-time instructor got only \$1000 for the year. These research assistants were expected to do chores in the department; one or two of them might be working on the *Annals*, reading proof sheets

and that sort of thing. Or there might be somebody who was writing a book or a long paper and wanted bibliographic assistance, that sort of thing.

Aspray: Yes.

Tucker: So there were really adequate funds available to support graduate and post-graduate work in the mathematics department. Practically all the applicants that the department really thought were promising applicants were given support.

Aspray: Yes.

Tucker: I should speak about the Institute for Advanced Study, which was founded by the Bambergers and Fulds of Newark, New Jersey, in 1930. They had become very much impressed by the ideas of Abraham Flexner for a center for research. The Institute for Advanced Study, as it was decided to call it, was incorporated in the state of New Jersey in 1930 and was supposed to be located in or around Newark, preferably in the state of New Jersey. Abraham Flexner then began a search for professors to start this institute. At an early stage, maybe even before 1930, Flexner became acquainted with Veblen, and Flexner selected Veblen to be the first professor at the Institute for Advanced Study. Veblen started making his plans for the School of Mathematics at the Institute. And Flexner traveled around the world picking up advice. I don't know exactly at what point it was decided to have the Institute at Princeton. I think that probably Veblen had a hand in that.

Aspray: So you think that Veblen was chosen before Princeton was chosen as the site?

Tucker: Perhaps.

Aspray: What were the reasons as far as you know for Veblen to have been the one chosen as the first faculty member?

Tucker: That I don't know.

Aspray: Any speculation?

Tucker: Well, I think it had partly to do with the fact that the Institute had to be in New Jersey, and the other people that Flexner might have gone to would most likely have been Birkhoff at Harvard or Bliss at Chicago.

Aspray: So he had already decided on mathematics by the time he chose Veblen.

Tucker: The deciding upon mathematics was apparently made quite early. I think Flexner tells this in his autobiography, the title of which is *I Remember*. He found much greater unanimity in the mathematical community as to who the outstanding people were than in

various other fields, and of course there was the hope when the Institute was about to be started that Albert Einstein could be brought as a professor to the Institute. Third, a practical reason, is that you could start a school of mathematics without equipment.

Aspray: Yes.

Tucker: Of course you needed a library, and Princeton University then had an excellent mathematics library, probably better than either Harvard or Chicago, not perhaps as good as Brown, which has always been credited with having the outstanding mathematics library in the United States.

Aspray: Yes.

Tucker: So Veblen chose two of his colleagues at his department of mathematics at Princeton for the School of Mathematics at the Institute. One of them James W. Alexander, who had been discovered by Veblen as an undergraduate and had written papers in topology with Veblen while he was still a graduate student, and John von Neumann who had come to Princeton in 1930 along with Eugene Wigner to share a professorship in mathematical physics.

Einstein, I think, declined the first offer that Flexner made to him. This would have been in 1931 or '32, but then events in Germany, the coming of Hitler, forced Einstein's hand. He was deprived of his German citizenship and no longer had any opportunity of holding an academic appointment, so he was glad to accept the appointment to the Institute for Advanced Study. He had been at Princeton to give some lectures in 1921, so he knew a bit about the town of Princeton and regarded it as an attractive place, not as attractive of course, as in a German-speaking country.

Hermann Weyl was also chosen as an initial professor in mathematics at the Institute. He had replaced Hilbert at Goettingen. Before that he had studied at Goettingen, but when Hilbert retired he was brought to Goettingen from Zurich where he had been a professor. Indeed the timing of that was such that when he came to Princeton for the year in '28-'29 he came from Zurich and brought Bohnenblust, who became a professor in our department, with him as an assistant. But after that year, when he was a visiting Jones Professor of Mathematical Physics, he returned briefly to Zurich and then took the post at Goettingen. But he had only been there a few months when things broke apart. His being chosen to go to Goettingen to replace Hilbert was the mark that here was one of the great, if not the greatest, mathematician of the time, certainly in the German speaking world. Mathematics was very much dominated by the German universities in the early part of the 20th century. When I came to Princeton as a graduate student in 1929 it seemed as though it would be impossible to do graduate study in mathematics unless you had a reading knowledge of German. Because I had grown up in Canada, where because of World War I the teaching of German had been deliberately stopped and was very slow to pick up again, I had to make some special effort in order to get training in German. It seemed absolutely necessary.

The Institute's School of Mathematics started out in the fall of 1933, housed in Fine Hall along with the department of mathematics. Indeed the three who had previously been at Princeton University, Veblen, Alexander, and von Neumann, just retained the offices that they had had. This resulted in the fact that Weyl, for example, didn't get as good an office as Veblen or Alexander had, but Weyl worked mainly at home, so his office didn't seem to matter so much to him. Of course a very nice office was found for Einstein; again he did not make a great deal of use of it. He was still in the habit of meeting with people he wanted to work with at his home. By that time Fine Hall had not quite yet established itself as the point where everybody gathered. Of course, Einstein all along did not like being in a crowd of people. He was not a recluse, but partly that.

Well, two factors I think in the mid Thirties that had an important influence on the mathematical atmosphere in Fine Hall. One of these was the coming of refugees, and Veblen was probably the most active of the American mathematicians in trying to find places for refugees from Europe.

Aspray: Now when you say, 'of the Americans', you mean of all Americans, not just at Princeton.

Tucker: Yes. There is this very thorough article by Nathaniel Reingold that documents the role played by Veblen. It's very clear that Veblen had a much more open attitude and welcoming attitude to the refugees than other mathematicians such as Birkhoff. Veblen seemed to have no fear at all that the refugees would take jobs away from young Americans. But that was a fear that Birkhoff and others very clearly had.

Aspray: Yes.

Tucker: So because Veblen was at the Institute for Advanced Study and because he had a very friendly attitude and sympathy for the refugees, the Institute became a stopping point for most of these refugees. And Veblen worked very hard to find positions. Perhaps they would be at the Institute for a few months, and then Veblen tried to find them ...

Aspray: ... more permanent positions.

Tucker: Yes. We heard from Leon Cohen about how this happened at the University of Kentucky, where a mathematician there went out and passed the hat on the main street at Frankfurt. And that's where two very great mathematicians were accommodated at that time. One of these was Richard Brauer, the algebraist. The other was ... oh, I can't think of his name right now, an associate of Courant. Someone who later on, years later, became for a few years, the director of the Courant Institute. [Friedrichs. A.T.]

The other thing, the other influence at that time, was the Depression in America.

Aspray: Yes.

Tucker: So there were young American mathematicians coming to the Institute with meager support. Veblen would try to find them support of some sort, but sometimes it was very meager. Indeed there were a group of young Americans at the Institute along about 1934 for whom Abraham Flexner found jobs in New York high schools. Part of Flexner's philosophy of education was that there should be high schools that had somewhat elite status, and that, as in Germany, the head of a department, a "gymnasium", should have a doctor's degree. And Abraham Flexner got people in the New York school system to try this out.

I don't think it worked very well. I knew quite well one of the candidates for this, George Garrison. He taught in a school near Times Square. It was called the Harlem Boys Annex. He very quickly learned that it was a blackboard jungle even at that time. He told me that the first time he went to the blackboard to write something down for the students to pay attention to, that a ripe tomato splashed into the blackboard just above his head. He said after that he always had a student write what he wanted on the blackboard while he stood at the back of the class to preserve discipline. He very quickly moved from teaching high school in New York to being an instructor at City College, CCNY. The point is that the refugees from Hitler and the poor job market in the United States for young mathematicians seemed to be the dominant influences at that particular time.

The mathematics that went on in Fine Hall was very rich, and there was no distinction made between the department of mathematics in the University and the School of Mathematics of the Institute. Everybody was just part of one large family. I was reading last night something that Agnes Fleming Henry had said at the wake that was held for the old Fine Hall when the move was made to the new Fine Hall. She referred to Fine Hall in the 1930s as the "Grand Hotel" of mathematics.

Of course, another factor in the theme of mathematics at Princeton was the journal *Annals of Mathematics*, which had been going for 50 years when ... let's see, it was started in 1884, so in 1934 it was 50 years of age. Princeton took it over in 1911, and from 1911 until about 1930 the principal editor was Wedderburn. He edited the journal in a very staid, matter-of-fact fashion, largely just attending to papers that came in. But then Lefschetz became the editor of the *Annals*. There was a short period in between when Einar Hille was the principal editor. Then Lefschetz joined Hille as editor, and then when Hille left to go to Yale, John von Neumann joined Lefschetz as editor—John von Neumann representing the Institute for Advanced Study and Lefschetz representing Princeton University.

It was Lefschetz who really set the tone. He was ably supported by von Neumann, but Lefschetz really regarded the *Annals*, as he would say, as his baby. He really set out to make that the leading mathematics journal in the world. And thanks to all the other things that were happening along about that time, he succeeded very well. So

the *Annals*, which is now 100 years old, has had a much more distinguished career in its last 50 years than in its first 50 years. And the eminence of the *Annals* as well as other publishing enterprises that were undertaken by the Princeton University Press for the mathematics community at Princeton, had, I think, a very important part in the fairly rapid development of the Princeton reputation in mathematics. With the *Annals* becoming a leading world journal and with the publications that I've talked about being disseminated all over the world, suddenly Princeton seemed to be the center of the mathematical world.

Aspray: How does one go about turning a somewhat ordinary journal into the leading journal in a field?

Tucker: Well, Lefschetz had a very good nose for papers. He would seek papers. As soon as he heard that somebody had done a nice piece of work, Lefschetz would try to get that paper for the *Annals*. He played a lot of favorites in doing this. Some people got their papers published much more rapidly than others. He made some enemies, of course, this way. But this rough way he had of fixing on quality, quality in his own judgement of course, was surprisingly successful. I wouldn't advocate this as the way an editor should in general behave, but Lefschetz managed to carry it off brilliantly.

Aspray: Could you tell me something about other appointments that were made to strengthen the department in the 1920s and 1930s?

Tucker: Appointments that were made in the '20s. Einar Hille in 1922, a Swedish mathematician, although American born, trained in Stockholm. A very fine analyst, he remained at Princeton until 1933 when he moved to Yale. Tracy Thomas took his doctor's degree with Veblen and Eisenhart and was here for two or three years as a National Research Fellow working with Veblen especially. Then he was appointed to the Princeton faculty in 1926. Lefschetz came in 1924 from the University of Kansas as a visiting professor and continued at Princeton until his retirement in 1953. Alonzo Church, who had been a Princeton undergraduate and a graduate student, was discovered by Veblen and became a protege of Veblen. He joined the faculty in 1929, after he had spent a year or two abroad, to Goettingen and Amsterdam, I think, on fellowship. Then, as I've already mentioned, von Neumann and Wigner came in 1930.