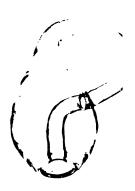LEIGH BUCHANAN BIENEN

Notes Found in a Klein Bottle

C AN it be that mathematicians are sentimental after all? At last month's dedication of the towering, new Fine Hall (which simultaneously tolled the bells for old Fine Hall), the Woodrow Wilson school auditorium was crowded with men with mathematical glints in their eyes. The subject? "Topology of an n-body problem"? No, that came on the next day during the topology conference following the opening ceremonies. What about "Kaehler Mainfolds with Positive Curvature"? Wrong again. They had come to hear a fond eulogy for that revered pile of bricks, old Fine Hall. The speakers, Solomon Lefschetz, Agnes Henry, and Salomon Bochner had chosen the topic of "Thirty Years in Old Fine Hall."

Of course, mathematicians are nothing if not accurate. In his introduction, Professor Albert Tucker dryly noted that the title of the talk was in error. The math department inhadited old Fine Hall from 1931 until 1969. An accurate rounding would have been up, not down. And especially because those 38 years were momentous both for Princeton University and for American mathematics.

Fine Hall, once a proud center of world mathematics, is a cheery little building huddled on the slope behind Prospect Garden. It was in its time a uniquely hospitable home for mathematicians and, in Agnes Henry's phrase, the Grand Hotel of Mathematics. The great figures in the field have passed through its sculptured doors, and many stayed to take up residence there.

The funds for the construction of this country's first mathematics building appeared only a few days after the death of Dean Henry Burchard Fine, the first departmental chairman. Thomas D. Jones 1876 and his family gave $600,000 in early 1929 for a building that would be a memorial to Jones' old friend, Harry Fine. It was a handsome sum in those days; it would be worth twice as much in today's money. The setting aside of $150,000 for the building's upkeep meant that it could be maintained without drawing on the University's general funds. (Now old Fine Hall has been re-named, appropriately, Jones Hall and is being used by the departments of Near Eastern and East Asian Studies.)

It was not the first time that the Jones family had helped along mathematics at Princeton. In 1926, Mr. Jones established the Fine Professorship, still one of the most distinguished mathematical chairs in the country. The family also contributed to the Scientific Research Fund that Fine guided to completion just before his death. This fund helped

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Leigh Bienen is a faculty wife and a regular PAW contributor. Her assertion that this history of Fine Hall and the mathematics department was found in a Klein Bottle seems improbable; a Klein Bottle is a one-sided topological curiosity (depicted above) and, from what we can tell, it's impossible to put anything inside of it.—ED.

Princeton take its pick from among the best graduate students and young faculty anywhere. There was no doubt about the name of the new building: it would be named after Dean Fine, the man who brought serious mathematicians to Princeton and made sure that Princeton would always be able to compete for the best talent in the field.

Good minds needed good design. J. Wedderburn, the algebraist, and Oswald Veblen, the geometer (also the nephew of Thorstein Veblen), took charge of the design and furnishing of the new mathematics hall. Veblen fancied the Oxbridge style. Carved oak panellings, heavy, spiked, wooden doors, leaded windows—all the 1929 American version of English Gothic. The offices featured splendid fireplaces, noble proportions. Five years later, the Depression would not have allowed such luxury on an academic building. The interior was dark and cool, stone corridors led through iron-laced doors. The windows were small and high, and everywhere was that rich, sensuous oak.

The planners even included a locker room so that mathematicians could shower after their heated arguments. Not all of the later occupants of Fine Hall have shared this theory, and not a few arguments have raged over which received less use, the showers or the fireplaces. There was a large Common Room for students, and another for the professors, again after the English model. One lecture room, Fine 100, seated more than 200.

Yet, surely, fine rugs and china do not mathematicians make. Mere gratitude for opulent surroundings will not spur scholars to greater productivity. Or will it? Everyone agrees that the building itself had a mystique. Its intimacy and its accessibility were important intangibles. Norman Steenrod, who now holds the Fine Professorship, remarks, "I learned as much as a third to a half of all I learned in graduate school in the Fine Hall Common Room. From seven in the evening until two or three in the morning, you could find someone to talk to." Poker and chess games went on all night. Later the Japanese game, Go, became a great favorite. The excellent library on the third floor was open 24 hours a day. People often arrived to work at night.

Fine, who had studied with Felix Klein and Leopold Kronecker and received his doctorate from the University of Leipzig, began the tradition of inviting outstanding foreign mathematicians to Princeton. Some came as visitors, others came permanently. Fine appointed Oswald Veblen, Gilbert Bliss, and John Wesley Young to preceptorships early in the century.

James Jeans came from England as professor of applied mathematics. James Alexander was recruited from within the department. Luther Eisenhart went up the ladder. When Young and Bliss left they were replaced by George Birkoff and J. Wedderburn. When Birkoff went to Harvard, Pierre Boutroux came from Paris. Thomas Gronwall and Einar Hille, both from Sweden, also joined the ranks about the same time. The best mathematicians in America were doing

their work at Princeton in the first decades of the century—and they had come from everywhere else. Fine's legacy was a cadre of first-class research mathematicians.

When Fine died, Eisenhart, who had joined the department in 1900, took over as chairman. Eisenhart also served as Dean of the Graduate School and Dean of the Faculty, and he was universally known as Dean Eisenhart. Like Veblen, Luther Eisenhart was a differential geometer. Like Fine, Eisenhart was devoted to the development of Princeton mathematics. He was President Dodd's adviser on all scientific matters. And he chaired the famous Scientific Research Committee from 1930 to 1945.

Fine Hall was to be more important than its planners could have ever foreseen. In the 1930's most graduate students were unmarried. There was no support for graduate work from the government or from foundations. Most students depended upon their families for help. Full board could be taken at Lahière's for seven dollars a week —and that was cheaper than living at the graduate school. Students, and even some younger faculty members, came, rented a bedroom in town, and then literally lived in Fine Hall. Every graduate student had a nook in the library where he could leave his books and papers. Some say there were cases of people who had to be gently encouraged not to always sleep in the building. And once a man aired his winter clothes on the back of the main door for the whole summer.

In 1930, the Institute for Advanced Study was founded in Princeton with Abraham Flexner as its director. The first Institute school was the School of Mathematics; the first Institute Professor was Oswald Veblen. Two additional mathematicians from the department were taken on at the Institute, Alexander and von Neumann. However, when Veblen, Alexander, and von Neumann left, there was no moving involved. The Institute had been offered space in Fine Hall until its own buildings were completed. And until Fuld Hall was finished in 1939, the Institute for Advanced Study stayed there. Not only did Veblen, Alexander, and von Neumann keep their old offices, but they continued to teach courses in the department.

The influx of foreign talent, which began with the arrival of Wedderburn in 1909, increased in the thirties. Scholars fled from country to country to keep ahead of the Nazis. First scholars of Jewish descent lost their university jobs. Einstein, in particular, was anathema to the Nazis. He was held up as an example of the worst kind of Jewish theoretical physicist. Einstein's kind of physics was contrasted with aryan physics, the physics of "defensive science," which had a high degree of relevance to war industry.

Scientists usually went first to England, and then from there many were found positions in American universities. Veblen was an important figure in this migration. A new strain was introduced into American science, and the next crossbred generation showed its bloodlines. Eugene Wigner and John von Neumann came together to the university in January 1930. Both had joint appointments in mathematics and physics. This too was Veblen's doing, Wigner recalls. "A Dutch physicist named Ehrenfest recommended to Veblen in 1928 that von Neumann and I should come together so that we would not feel too isolated. At that time von Neumann was at the University of Berlin, and I was at the Technical Institute in Berlin. We were both given appointments which allowed us to spend half of the year in Germany and half of the year in Princeton. I came and took a room at 24 Dickinson Street. I hardly spoke any English, only what I had learned on the boat. I remember my first impression of Fine Hall because the office was so neat and nice. The only thing that I missed right away was a wastebasket. Einstein said that the most important implement for a theoretical physicist was a wastebasket, and I straightaway went out and bought one. Later I was issued an official Fine Hall wastebasket. And look," Wigner points to the overflowing receptacle beside the old Fine Hall desk which is in his new Jadwin office, "I still believe that."

It's not difficult to see why mathematicians and physicists found Fine Hall hard to leave in the thirties. Down the hall were Einstein and von Neumann, Lefschetz, Veblen and Alexander, Wigner and Hermann Weyl, Bochner, H. P. Robertson, and P.A.M. Dirac, and others.

Tea was served in the Common Room every day at four o'clock. And the story is told about the logician Alonzo Church, one of the several purebred Princeton products around (BA '24, Ph.D. '27, and faculty member for more than 30 years), that he used to arrive in Fine Hall about 5:30, pour the remaining contents of the cream pitcher into the tea pot, add quantities of sugar, and then drink the gluey mixture from the spout. This was before he started work. His habit was to work through the night and leave the building in the morning.

For a mathematician or scientist, Fine Hall filled almost every need, except that it didn't serve meals and there weren't many women around. The offices were sumptuous living rooms. The corner studies were the prized ones; they were handed down. Einstein's went to Wigner; Veblen's to Church; Alexander's to Robertson and then to Tucker. Behind almost every door was a great scientist. Or as one caustic commentator put it, "In those days everyone was a great mathematician or thought himself one." A surprisingly high percentage were the real thing.

Veblen, who made his personal tastes felt in the design and decoration of Fine Hall was also central to the intellectual development of the department. Veblen was a geometer who at different stages of his career dealt with different kinds of geometry. He started out as a projective geometer. This got him into *analysis situs*, the Latin name for the subject we now know by its name derived from the Greek, topology. Veblen specialized in various areas of mathematics, but always with an emphasis on geometry. Veblen's interest in the foundations of geometry carried over to an interest in physics. This connection with physics has remained another persistent theme. While mathematicians such as von Neumann can hardly be termed "applied" mathematicians, the kind of mathematics they do sinks deep roots into physics. Today in keeping with this, there are three joint appointments with physics.

James Alexander was an outstanding student of Veblen. When Alexander was joined by Solomon Lefschetz, Princeton became the world center for algebraic topology. Ralph Fox and Norman Steenrod, two students of Lefschetz were later additions who have continued this tradition. Tucker also started out as a topologist. In the thirties almost everything that was being done in that field was being done here, and Princeton is still one of the world centers for topology.

Lefschetz recalls, "When I came in 1924 there were only seven men here engaged in mathematical research. These

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were Fine, Eisenhart, Veblen, Wedderburn, Alexander, Einar Hille and myself. In the beginning we had no quarters. Everyone worked at home. Two rooms in Palmer had been assigned to us. One was used as a library, and the other for everything else! Only three members of the department had offices. Fine and Eisenhart had offices in Nassau Hall, and Veblen had an office in Palmer. But even in those days, and this tradition has continued, there was no *chi chi*. Things were done without fuss. People left their doors unlocked and open. Everyone knew one another.

"I myself never had much use for this organization of the department into full professors, assistant professors, and instructors. And I never paid attention to rank. There was only one car, Veblen's, in the department. Everyone walked to and from the office. Things were simpler in those days. There was only one graduate seminar given every year. I remember one year not long after I came it was given on Tensor Analysis. Now I wasn't particularly interested in Tensor Analysis. In fact I rather disliked the subject. Nevertheless, I of course attended the seminar, like everyone else."

Albert Tucker, another Princeton Ph.D. from the glory days, explains the phenomenon in another way. "The greatness of the mathematics department," he comments, "was a series of pieces of luck. The first piece of luck was that when Woodrow Wilson started the preceptorial system in 1905, it resulted in able mathematicians being brought here. Another stroke of luck was Dean Fine being made Dean of Sciences in the twenties—the position occupied by Lyman Spitzer now. He decided then that more money was needed for scientific research. The third stroke of luck was the locating of the Institute in Fine Hall."

If the connections between the Institute for Advanced Study and the mathematics department were especially close in the thirties, the two institutions have remained symbiotic. Many mathematicians would not find the Institute so attractive were it not near the university. And scholars at Princeton have benefited greatly from the proximity of Institute members.

The Institute schedule of lectures and events is still posted on the departmental notice board, and the departmental calendar is on the Institute Bulletin board. These influences have often gone far beyond social niceties or personal friendships. "Because von Neumann was here," Tucker notes, "there was an early interest in game theory at Princeton. We conducted a seminar on the subject in 1948 which von Neumann used to attend regularly." That surely must have been one of the first seminars on game theory ever given.

"Mathematics is a science with an oral tradition," emphasizes Elias Stein, the current department chairman. "The published form of mathematical work often belies the process. The actual doing of mathematics is most often accomplished by small groups standing in front of a blackboard. And a student who simply reads published papers, rather than sees work being done, will miss a good deal of the process." The intuitive side of the thinking, the order in which steps were taken, the jumps, are not expressed in the finished work where proofs and deductions are laid down with a view to logic and elegance.

With the coming of World War II everything changed. The Institute had moved into Fuld Hall in 1939. The old leisurely, aristocratic habits were put aside. Graduate studies almost came to a halt, and undergraduate work was also greatly curtailed. Members of the department all became engaged in some kind of work outside of their ordinary teaching and research. Everyone worked ten hours a day. Several joint projects ran concurrently. Research interests were changed and modified. Professor Tukey had been working in topology before the war; he had been a student of Lefschetz. As a result of his wartime research he became interested in statistics and has continued in that field.

WHEN the war ended, things never returned to the old, informal basis. The days of Fine as an elegant club for mathematicians were over. The first important difference after the war was that the graduate students were married. Also, there was money, money for research and for students, money from the government, and from agencies and foundations. Several different projects were set up involving students and faculty. There were projects on topology, statistics, and analysis. The department expanded. During the thirties the number of graduate students slowly increased, from 15 around 1929 to about 30 in 1939. After the war there were about 50.

John Milnor, another Princeton B.A. and Ph.D. and faculty member who will be coming to the Institute permanently next year, says that "The critical thing about being a mathematics student at Princeton was the amount of attention each individual student received." Of course in Milnor's case everyone was watching him after the word slipped that as an undergraduate he had proved an unsolved topological conjecture about a knotted curve in space. And before his dissertation was finished, he had already published several papers. But perhaps it is not pure coincidence that Milnor first worked in topology, with Lefschetz's two students, Steenrod and Fox. Now, he notes, his interests have shifted back to algebra.

In 1945, Dean Eisenhart retired and Solomon Lefschetz took over the chair with Tucker as second in command. One of the first important post-war events was the bicentennial Conference on Problems of Mathematics in 1946. Its intent was to bring together the international community of mathematicians who had been out of contact during the war years. "Our conference became the first international gathering of mathematicians in a long and terrible decade," Lefschetz notes.

Lefschetz goes on to describe his tenure as chairman by saying, "My one principle as chairman was to appoint only first-rate mathematicians to the department. To replace men like Alexander or Veblen or Thomas or Chevalley necessarily took several years. Once I had appointed strong men, then it was my philosophy to let them do exactly as they pleased. But it's impossible to have complete control. You cannot persuade everyone you would like to have to come, nor does everyone who comes stay on. Still, we made some very strong appointments. There were Steenrod and Fox, Tracy Thomas who worked in the theory of tensors and differential geometry, Emil Artin, who came in 1946 as an algebraist and analyst and a splendid teacher, William Feller, who did his fine work in probability, and, of course, Tucker and Tukey."

"When I took over as chairman of the department in 1953," Professor Tucker reports, "I was only the fourth chairman in this century!" Fine served from 1905 until his death in 1928; Eisenhart from 1928-1945; Lefschetz from 1945-1953, and Tucker from 1953-1963. Tucker also

tells an illuminating story about the development of his famous Kuhn-Tucker theory. "I got into the field as a result of a series of circumstances. Dantzig, who was then at the Pentagon, came to von Neumann in the spring of 1948 to inquire about setting up a research project. The subject was to be the relationship between game theory and linear programming. This was intended only as a summer project. Two graduate students, Kuhn and Gale, were to work with me on the problem. All three of us thought that what we were doing was only a temporary concern. I expected to return to topology. Gale left the project. And what came out was called for want of a better term, Kuhn-Tucker theory. Although this is the work I am best known for, I consider my major work to have been done in the field of combinatorial mathematics." This "summer project" is now in its third decade and still going strong.

The Princeton University Press has earned a fine reputation as a mathematical publisher. Before the war, excellent mathematical manuscripts often went begging. The *Princeton Mathematical Series*, edited by Marston Morse at the Institute and A. Tucker, broke the log jam. And now commercial publishers vigorously compete for mathematical manuscripts. The Press also publishes the *Annals of Mathematical Studies*, which are a series of book-length works published in a soft cover that sports the orange and black

colors. The *Annals of Mathematics*, one of the leading journals in the field, is also edited and published here. Recently a third series was started, a more informal kind of publication, called the *Princeton Mathematical Notes*.

The style of Fine Hall, and the scientific work done there, both mark off an era. And the quality of excellence continues to grow. Shortly before his death this year, Dr. William Feller, Eugene Higgins Professor of Mathematics, was honored by President Nixon with a National Medal of Science for his "original and definitive contributions to pure and applied mathematics, for making probability available to users, for pioneering work in establishing *Mathematical Reviews*." A month later, John Kemeny '43 and mathematics *46, once an associate of Einstein, was appointed president of Dartmouth.

Dean Fine has been appropriately memorialized in the two buildings that bore his name. And it is one of the ironies that Woodrow Wilson, who himself regarded mathematics as a torture, was partly responsible for the stature of the mathematics department. "Now," Lefschetz notes wistfully, "there are only two living mathematicians in Princeton who remember Dean Fine—Alexander and myself." But there are mathematicians all over the world for whom Fine Hall—both old and new—means something special about the development of American mathematics.

Memorials

JAMES SMYLIE KINNE '01

JAMES SMYLIE KINNE died March 11, 1970. He was born Nov. 21, 1879 in Paterson, N.J., the son of Dr. Porter S. and Amelia Smylie Kinne. He prepared for Princeton at the Newark Academy. While an undergraduate he considered his best achievements to be his participation in the formation of the University's first band and the formation of its first basketball team of which he was manager. Upon graduation he spent the first two years working in his uncle's firm, Frank T. May Jewelry Co. in NYC. The next two years he worked for the Cooper Wig Steel Casting Co. at Delawanna, N.J. Then he formed his own, the Riverside Steel Casting Co., of which he was secretary and treasurer and remained with them 24 years. He then became executive director of the Medical-Dental Service Bureau in Paterson, N.J. He was also a member of the Borough Council of Franklin Lakes where he lived and the recorder and magistrate. He was a trustee of the Westside Presbyterian Church in Ridgewood, N.J. For many years he was our Class Treasurer and at Reunions he was the "Leader of the Band."

In 1911 he married Helen Baldwin who survives him and a son, James S. of San Carlos, Calif., two daughters, Marjory, Mrs. David L. Tewilliger of Franklin Lakes and Janet, Mrs. Thomas J. Graham, ten grandchildren and seven great-grandchildren, to whom the Class sends its deep sympathy.

The Class of 1901

THOMAS ROSE MATHEWS '06

Tom Mathews died Feb. 11, 1970 in the Euclid General Hospital.

He prepared for college at the Cleveland South High School. He left college in the fall of senior year and from that time was actively engaged in various companies in the Cleveland area. In 1908 he ventured forth on a prospecting project in the Cobalt district in silver mining.

Returning to Cleveland, Tom was engaged in advertising and managerial positions with firms in that area, specializing in the metal trades, chiefly steel products. In later years he was handicapped by ill health which at times severely interfered with his business activities. For the past several years he lived with his daughter Alice in Mentor.

While in college, Tom was active in the musical organizations and the Glee Club. Despite the illnesses of his later years, he retained his cheerful disposition and his ability to pass a merry quip.

He is survived by his daughter Miss Alice Mathews. His wife, Lucy, predeceased him several years ago.

An expression of deep sympathy is extended to his daughter.

The Class of 1906

ROBERT C. CLOTHIER '08

BOB CLOTHIER, former president of Rutgers University from 1932 to 1951 and president of our class for the past 19 years, died suddenly on March 18, 1970 following a fatal head injury due to a fall. Under his leadership, Rutgers grew from a small college of 2,900 students to an enrollment of 21,000 students when he retired in 1951. He was responsible for starting the Graduate School of Banking, Bureau of Mineral Research, Institute of Management and Labor Relations and the Institute of Microbiology. He also was president of the convention which produced New Jersey's new constitution in 1947.

Before becoming the president of Rutgers he had been assistant headmaster of the Haverford School, Dean of Men at the Univ. of Pittsburgh and earlier had been employment manager of the Curtis Publishing Co., and a vice-president of V. P. Scott Co., industrial consultants.

During World War I he was a Lt. Colonel on the Army General Staff and served overseas as a representative of the Secretary of War studying the procedures and technical skills of the British and French forces. He lost a son, Arthur, in World War II.

His former directorships included the Thomas Alva Edison Foundation, the Public Service Electric and Gas Co. of N.J., the Mutual Benefit Life Insurance Co. The Robert Wood Johnson Foundation, the Rittenhouse Fund and a directorship in the Haverford School and the Baldwin School.

Surviving are a son, Robert C. Clothier, Jr. '50, a sister Miss Marion Clothier and four grandchildren to whom the class extends sincere sympathy.

The Class of 1908

THURMAN ARNOLD '11

THURMAN ARNOLD died on Nov. 7, 1969 at his home in Alexandria, Va. He was born in Laramie, Wyo. on June 2, 1891, the son of Constantine Peter and Annie Brockway Arnold.

Thurman entered Princeton in sophomore year, transferring from Wabash College. He was a member of Clio and an editor of the Nassau Literary Magazine. Thurman was awarded high honors in history, politics and economics, and graduated Phi Beta Kappa. He was the youngest member of the Class.

He received his LLB degree from Harvard Law School in 1914, and began his career in Chicago and then helped form the law firm of O'Brien, Waite & Arnold.

In 1919 Thurman returned to Laramie, became a member of his father's firm of Arnold, Patterson & Arnold and a lecturer in law at the Univ. of Wyoming from 1921 through 1926. He was elected to the Wyoming House of Representatives in 1921, the only Democrat in that body, and was mayor of Laramie for the 1923-1924 term of office.

He was dean of the College of Law of the Univ. of West Virginia from 1927 to 1930. In 1931 Thurman was appointed professor of law at Yale, and served until 1938. He also served as special assistant to the General Counsel of the Agricultural Adjustment Administration and in 1934 was made legal adviser to the Governor General of the Philippines.

In 1938 Thurman was appointed Assistant Attorney General of the U.S. in charge of the Antitrust Division of the Justice Dept. During a five-year period he instituted 230 suits, more than the total in the previous 50-year history of the Sherman Act and won almost every major case. He also was a member of the Temporary National Economy Committee, representing the Dept. of Justice, from 1938 through 1941.

Thurman was appointed Associate Justice of the U.S. Court of Appeals for the District of Columbia in March 1943, a lifetime appointment from which he resigned in July 1945.

He then formed the Washington law firm of

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