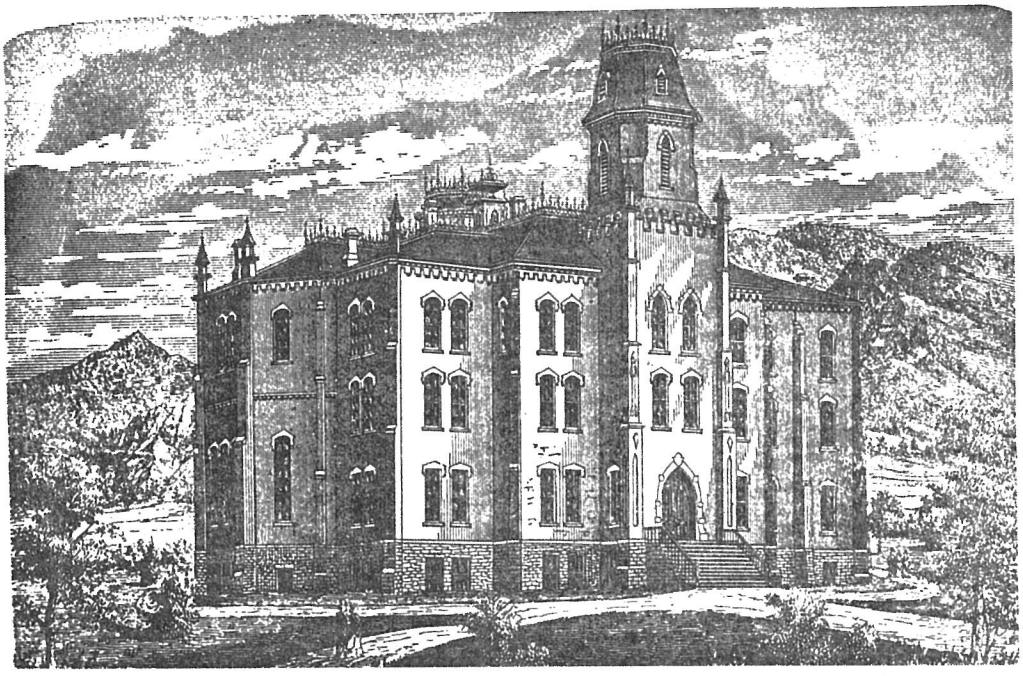
A History of the Mathematics Departments of the University of Colorado

by
Burton W. Jones
and
Wolfgang Thron



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Preface

The first impetus for the writing of this history was the following suggestion in a letter which Phillip S. Jones of the University of Michigan wrote to Burton Jones on August 1, 1976: "Why don't you prod someone to do a historical summary, at least, of mathematics at Colorado." Bebernes, chairman of the department, thought it a good idea and since that time we have been prodding each other.

Phillip Jones may not have realized that he was only continuing the early influences which his university had on ours. For it is apparent from our first chapter that the University of Michigan was looked up to by those who wrote the first Boulder County Directory, that it provided a model for our curriculum and was the place from which a number of our early faculty came. Nor has there been a complete absence of such influence since that time.

Our concern has been with those faculty and students who shaped the development of mathematics at this University, the impact which these persons had outside the institution, and even the participation of certain members of the department in civic affairs only peripherally related to mathematics. We were interested, too, in the interaction between the department and its environment through the years as we traced its growth from infancy, through adolescence to adulthood.

We have taken advantage of the fact that we are not historians to refrain from annotating in footnotes the sources of our information. Indeed most of the books listed in the bibliography would probably be classified as secondary sources. Aside from these our chief sources were: catalogues, directories and commencement programs of the University in its archives, alumni lists, records as we could find them in various offices of this institution such as minutes of the Board of Regents, "American Men and Women of Science", publications of the American Mathematical Society and the Mathematical Association of America, and the histories of the Mathematics Departments of the Universities of Kansas and Illinois. The archives of the City of Boulder and the files of the Boulder *Daily Camera* through the good auspices of Laurence Paddock, have been very useful. Much of our information came from word of mouth and in response to letters written. We have tried hard to keep errors of fact to a minimum.

It would be fruitless to try to pinpoint the division of labor between us for we both, together with the secretaries, gathered information. But Jones is primarily responsible for writing the first four chapters and the first four paragraphs of Chapter V, while Thron is chiefly responsible for the rest including the information in the appendices. The reader will notice that the account in Chapter V of the department since the merger is far from complete, because a history must relate to the past. We hope that, say twenty-five years from now, one or more members of the department will have the interest and perspective to write a chapter about the years 1966-81.

We are grateful to all those, within and outside the University, who helped us gather information, to Bebernes for his encouragement and guidance as well as his making available departmental secreties Susan LeCraft, first, and then Cathy Sweet for the gathering of information and typing of the various drafts. The latter especially has been an invaluable and enthusiastic helper. Finally we acknowledge with gratitude the financial help of The Colorado Foundation and the Department of Mathematics in this enterprise.

Burton Jones and Wolfgang Thron

I

The First Fifty Years
1876-1925

Though 1876 is given as the founding year of the University of Colorado, the only tangible evidence then of its existence was a building (now Old Main), finally completed in July of that year, and the fifty-two acres on which it was built. The first full working meeting of the Regents was on March 27, 1877 when they elected two faculty members: President Joseph Sewall (Ph.D. Harvard) and Professor Justin E. Dow, formerly principal of Boulder's High School, at salaries of $3000 and $2000 respectively. The first students were enrolled on the 5th of September, 1877—34 of whom were in the preparatory course and 10 in university classes. By 1880 the entrance requirements to the University courses were: three years of Latin, two of Greek, and mathematics as far as spherical trigonometry. The first graduating class, consisting of six students, received their degrees in 1882. The financial support of the University was minimal, consisting of one-fifth of a mil (by 1904 raised to two-fifths) of the total state property tax and whatever special appropriations could be obtained from the legislature from time to time.

At least in certain quarters the *verbal* support of the University was impressive. In the Boulder County Directory of 1892 (the first of its kind) can be found the following words of praise:

> "The scientific departments [of the University] are in the hands of as competent instructors as can be found in any like institution. . . The Scientific Building [named after Horace Morrison Hale, President of the University from 1887 to 1892] is a very handsome stone structure, just completed and when fitted with aparatus and paraphernalia will cost in the neighborhood of $100,000. . . The second story will be devoted entirely to the needs of the Mathematics Department. . . The State University should be the pride of every citizen of Colorado. It is not in any sense a local institution, but the head of the public school and college systems of the state. It should be looked upon by the people of Colorado in the same light as is the University of Michigan at Ann Arbor by the people of that state. . . The tuition is as free as Colorado sunshine, and the cost of board,

> light and heat upon the campus is only $3.75 a week. For this slight expense the young men and women of Colorado may secure a classical education and stand equal with the graduates of the best institutions of learning in the land... There are few, if any, cities in the whole United States that can offer greater advantages to the capitalist or home seeker than 'BOULDER THE BEAUTIFUL'."

Notwithstanding these fine words, schooling in Boulder was minimal and consequently before the turn of the century an important part of the university curriculum was the preparatory course. In fact, when the University began (F. O. Repplier, "As A Town Grows") the Boulder School Board decided to close its High School and send its students to the new Preparatory School at the University. As late as 1893 the Preparatory Department's courses enrolled more students than the rest of the University. And it was not until 1907 that this ceased to be part of the University; this was accomplished only by using some of the university's meagre funds to support the public schools. However, this kind of situation was not peculiar to Colorado. At the University of Kansas, ten years older than the University of Colorado, preparatory courses were not eliminated from its curriculum until twenty-five years after its founding, nor are preparatory classes lacking at universities today.

Until 1890 when the State Normal School was established at Greeley, there was no teacher-training institution in Colorado outside of Boulder. So an important part of the university curriculum up to that time was also a normal course.

In 1878, Frank W. Gove, from the Denver Public Schools, came as an instructor (also designated as "tutor") of mathematics at a salary of $1100. The following year he was succeeded by Paul H. Hanus with the same title at a salary of $1200. Hanus's autobiography (*Adventuring in Education*, Harvard University Press, 1937) begins as follows:

> "In upper Silesia, in Prussia, there is a picturesque village, Hermsdorf unter dem Kynast, where I was born on March 14, 1855. A turbulent stream from the Riesengebirge (Giant Mountains) rushes pellmell through the town. A huge crag, the Kynast, more than a thousand feet high, rises sheer from the valley of the stream. On the top of the Kynast, inaccessible save at one point to which winds a steep road, is the ivy-covered ruin of a not large but rather impressive castle."

Hanus's Family moved to Mineral Point, Wisconsin, where his widowed mother was to marry Mr. George. Hanus received a B.S. degree at the University of Michigan in 1878 where one of his teachers was Professor Olney, author of a number of elementary textbooks which Hanus later used at the University of Colorado. He came to Boulder after a year of teaching in Denver High School. Since at the end of two years he was given praise but no prospect of promotion or increase in salary, he

left for a year to join a friend in a prosperous venture as proprietors of a drug store in Denver. He wrote that "at the end of the year I entered into correspondence with the university authorities, suggesting that I should be glad to return to the University if they would appoint me full professor of mathematics with the corresponding salary." So he returned to the department at a salary of $1900 with the rank of professor.

The mathematics courses listed in the catalogue of 1883 with brief descriptions were: Algebra, including a little theory of equations; Solid and Spherical Trigonometry, Trigonometry, General Geometry (Analytic Geometry); and Differential and Integral Calculus (all using textbooks by Olney). This was the first year that calculus was listed. But this is not surprising in relation to offerings in other institutions of the country. In the first 22 years of its existence (1841-1863), the University of Michigan, which set the pattern for much of the early curriculum of the University of Colorado, offered nothing beyond calculus. One of those who received his B.A. degree in 1886, Fred Chase, went on to get his Ph.D. degree at Yale University in 1891, probably in astronomy.

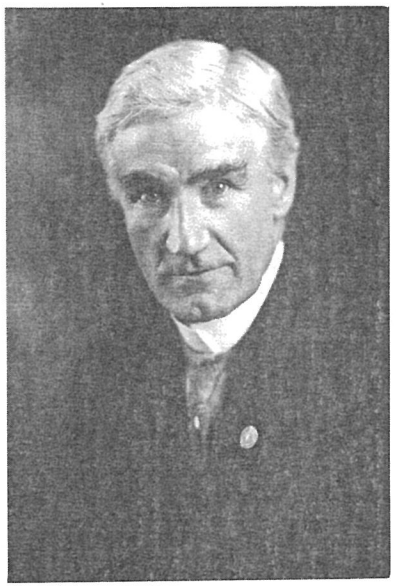
The situation was similar at the University of Illinois. In fact throughout this country the classics formed the prestigious part of the curriculum of higher education. Such subjects as mathematics and science were merely utilitarian.

Hanus wrote a book on determinants (Ginn & Co., 1886); he taught a course in geology; he visited many schools in the state and also in Boston and Baltimore. He remarked that it was four hours to Denver by train and three by horseback. In Boston he called on President Eliot of Harvard University, the father of his Unitarian pastor in Denver, who gave him a letter of introduction to B. O. Pierce and W. E. Byerley. In Baltimore he attended a farewell reception of J. J. Sylvester, who was about to return to England. However, during these years his interests were turning toward education. Also the University was having its troubles under President Sewall. So in 1886 he resigned to become principal of a Denver High School, conducted institutes throughout the state, and was professor of pedagogy at Colorado State Normal School for one year.

In the spring of 1891 at the home of his son, President Eliot invited Hanus to become assistant professor of History and Art of Teaching at Harvard University at a salary of $2000. His duties were to give lectures on the subjects of his title, conduct summer school courses and institutes for teachers, visit schools which "feed the university" and act as "general agent" for the new Normal Department. In effect he was to establish a Department of Education. There was some skepticism on the part of the faculty but they were willing to wait and see. Two of those most helpful to him in developing a program were Josiah Royce and William James. Under Hanus the department progressed in prestige within the university and outside and became the Graduate School of Education in 1920, the year before his retirement. On his 75th birthday, at a dinner in his honor, a bronze bas-relief plaque was placed in Lawrence Hall. The University of Colorado gave him an LL.D. degree in 1906 and the University of Michigan conferred a similar degree on him in

Paul H. Hanus
(From "Adventuring in Education")

Charles Sperry
(From The Daily Camera, Boulder)



Ira M. DeLong
(University of Colorado Photo)

Saul Epsteen
(University of Colorado Photo)

1925. He died in 1941 at the age of 86.

Hanus was succeeded by his classmate at the University of Michigan, William W. Campbell who left Colorado in 1888 for a distinguished career ranging from the Detroit Observatory of the University of Michigan to the Lick Observatory at the University of California. He was the President of the University of California from 1923 to 1930 and President of the National Academy of Sciences from 1931 to 1935. He received four honorary degrees including an LL.D. degree from the University of Wisconsin in 1902.

During the incumbency of Hanus and Campbell courses were listed in quaternions (using books of Hardy, Tait, and Hamilton) and in curve tracing. Descriptive astronomy courses had been listed almost from the beginning of the University but within the Physics Department or coupled with Natural Philosophy. In 1888 the entire faculty of the University consisted of three professors, including Campbell, two lecturers, one "demonstrator" in Medicine, and one "tutor". Thirty-one of the 136 students were in the Philosophy and Arts Program.

In the fall of 1888, Ira Mitchell DeLong came to the University at an initial salary of $1600, where he was to serve as Professor of Mathematics and Head of the department until his retirement in 1925. He had received an M.A. degree from Simpson College in Iowa in 1881. His interests and capabilities were very broad. He was a charter member of the New York Mathematical Society (later, the American Mathematical Society), being elected in May of 1891. He established the Problem Department of "School Science and Mathematics" and edited it for three years. He was one of the founders of the Colorado Mathematical Society in 1905 and was its President from 1905 to 1907 and from 1912 to 1914. With his colleagues Miss Kendall, C. S. Sperry and O. C. Lester of the Physics Department he became a charter member of the Mathematical Association of America and was instrumental in forming the Rocky Mountain Section of the Association (the ninth section chronologically) when it succeeded the Colorado Mathematical Society in 1917.

He came at a time of fast growth in Boulder. From a population of 343 in 1870, it grew to 3,069 in 1880 and 6,150 in 1900 partly due to the opening of the railroad to Denver in 1873. Another link with Denver, the interurban cars, was established in 1908 and continued until 1926. From the founding of the University, the character of the city of Boulder underwent profound changes. In the Directory of 1892, many towns were listed which have long since vanished, such as Crisman, Caribou and Magnolia. Most of the inhabitants of these towns were miners; and Boulder was the place where the narrow gauge railroads from the surrounding mines converged to meet the standard gauge lines to Denver and elsewhere. Then as the mines waned, the narrow gauge railroads were used for excursions into the mountains by students and citizens of the city. The people were beginning to have more leisure time and the interest in cultural affairs was increasing.

DeLong was influential in the growing city. He organized the Boulder Building and Loan Association in 1890 and was active in the corresponding state organiza-

tion. He was president of a commission of 23 persons elected by the city of Boulder to draw up a city charter and constitution in 1917. The part of the constitution which bears his special mark is the lengthy description of the Hare Preferential Ballot which was used, in spite of some strong opposition, until the 1940's. He represented the University in its dealings with the state legislature. In 1914 the University of Denver awarded him an LL.D. degree.

In the schools of the state, DeLong was a proponent of the so-called Perry Movement. John Perry, a physics teacher in a newly formed private school in England, advocated greater emphasis on applications of mathematics and the decompartmentalization of subject matter. This was the movement described and advocated by E. H. Moore of the University of Chicago in his 1902 address as retiring President of the American Mathematical Society.

Two of DeLong's students deserve special mention. One was Miss Kendall who became a long-time member of the department. The other was Charles R. Burger who, after receiving his B. Ph. degree from the University in 1892 went on to Harvard to receive his B.A. in 1893. After one year as a graduate fellow at Clark University he taught in the schools of Denver until going to Colorado School of Mines in 1903.

The first department member with a Ph.D. degree was Thomas L. Blakeslee who was an assistant in mathematics for the academic year 1898-99, but we know very little about him. On the other hand there is much information about Arnold Emch who was assistant professor of Pure and Applied Mathematics and professor of Graphics and Mathematics from 1900 to 1905. He was a native of Switzerland and received his B.A. degree from the Swiss Polytechnic Institute in 1893 and his Ph.D. degree from the University of Kansas in 1895. He was the first person to receive a Ph.D. degree in any subject from that institution. His beginning salary of $500 was increased to $1200 the following year and later to $1500. He left the University of Colorado in 1905 to assume a position in Solothum College of Switzerland, from which he had come, and in 1911 was appointed to an assistant professorship at the University of Illinois, where he remained for the rest of his notable academic career. For instance, from 1927 to 1928 he was a member of the National Research Council's committee on Algebraic Geometry.

In the American Mathematical Monthly of 1905 appeared the note:

> "Dr. Saul Epsteen has been elected to the Chair of Applied Mathematics at the University of Colorado to replace Arnold Emch who has returned to a position in his alma mater."

The following appeared in the Boulder *Camera* on the 17th of June, 1905:

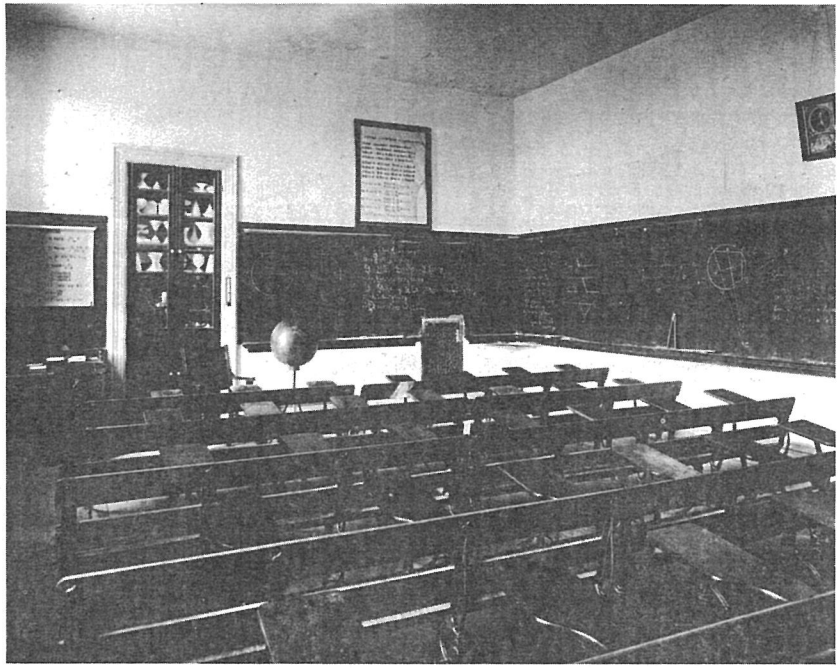
"BRILLIANT MAN COMING"

President Baker lands distinguished successor to Emch

> Professor Ira M. DeLong received a message from President Baker this afternoon that caused him great satisfaction. The successor to Dr. Arnold Emch, of the Mathematical Department of the University, has been secured by Dr. Baker in the person of Dr. Samuel Epstun [Saul Epsteen]. This gentleman was born in San Francisco, took his B. of S. degree at the University of Colorado [actually California] in 1900, Doctor of Philosophy at the University of Zurich, Switzerland, in '01, further studied at Goltingen [Göttingen], Germany in '01 and '02 and since has been instructor in mathematics at the University of Chicago. His contributions to scientific journals have given him great fame."

In fact, Epsteen's appointment was to an instructorship in mathematics at a salary of $800. (Perhaps part of President Baker's elation was at securing a fine person at such a low salary.) The following year he was made head of the Mathematics Department of the newly established College of Engineering (see below) with the rank of assistant professor but no increase in salary. (DeLong's salary from 1904 to 1910 was $2500.) Epsteen was an Associate in Mathematics at the University of Chicago from 1903 to 1905. While there he was an associate editor of the American Mathematical Monthly in charge of the Problems and Solutions Department while B. F. Finkel was studying at the University of Pennsylvania. He collaborated with J. H. M. Wedderburn, then a Carnegie Research Scholar, in writing a paper on hypercomplex number systems that contained theorems analogous to some in the theory of continuous groups. [The definition of hypercomplex numbers was given by Benjamin Peirce in 1881; this subject was the precursor of linear associative algebras.] This paper appeared in the Transactions of the American Mathematical Society of 1906. Epsteen also collaborated with H. B. Leonard, who later accompanied him to the University of Colorado. The paper "On the definition of reducible hypercomplex number systems", appeared in 1905 in volume 27 of the *American Journal of Mathematics* (pp. 217-242). They acknowledged helpful suggestions from E. H. Moore. An interesting sentence from the paper is "From Table I it can be seen that there are 78 different ways of defining the reducibility of a hypercomplex number system." He wrote at least 18 papers appearing in journals of the American Mathematical Society and the Mathematical Association of America.

Epsteen was head of the Department of Engineering Mathematics from 1906 until his departure in 1913. From the formation of the Graduate School of the



"DE LONG ROOM"

Photo by J. R. Brackett
Notes by A. A. Bartlett 8/3/1973

This is the math classroom of Professor Ira DeLong and it probably is in Main. Above the desk at the left is a chart of trigonometric identities. In the cabinet are string and plaster models of various mathematical surfaces. On the board are the steps in deriving the expression for the n^{th} derivative with respect to x of $y = \tan^{-1}(1/x)$. On the right board is a problem in plane trigonometry, "Find Height of Fort". It is interesting to note the details of the calculations which use six place logarithms to the base 10. An error has been made in the line "ΔBED log c = 2.285874". This should be 2.285974 with the result that the answer should be 136.60 ft. while they give 136.59. Using his incorrect answer for log c gives a final answer 136.57 ft. which is off more than it should be for calculation with six place logarithms. Above the boards are a table of relations in spherical trigonometry and a picture of Isaac Newton.

This would seem to be room 209 in the NW corner of the second floor of Main. No trace remains (in 1976) of the cabinet with models or of the ornate iron register, although the duct to serve the register is available in the next room east. A thermometer hangs on the right frame of the closet. (1893 spring is the probable date of the photo.)

University in 1909, with Dr. Brackett as Dean, to 1913, he was the secretary of that body.

In the period up to 1905 there was not much expansion in the course offerings. Courses in "Theory of Functions" and "Modern Higher Algebra" were listed from 1898 and 1899, respectively, to 1901, as well as one in Fourier Series. A course in the History of Mathematics was regularly listed from 1889 onward. Since few descriptions were included in the catalogues, it is difficult to determine their content or, indeed, whether they were actually given. In 1905 there were 743 students in all programs of the University. the members of the department then listed were: DeLong, Epsteen and one assistant.

In the fall of 1906 what was one department became two in the formation of the Department of Engineering Mathematics of the newly formed College of Engineering under Dean Milo Ketchum. The following statement appears in the minutes of the Board of Regents:

> "Moved and carried that Professor Epsteen and one assistant be transferred to the Engineering School. That Professor DeLong and one assistant attend to the balance of the mathematics at the University. That the Board disproves and refuses to employ any additional instructors or assistants for the individual instruction in the Department of Mathematics, and insists that Professor DeLong and his assistants secure good results at a good standard."

Apparently the Board soon relented, for beginning in 1908, DeLong had the assistance of others variously titled as assistant or instructor. Indeed for a number of years the sizes of the staffs of the two departments were comparable. Since the history of the Department of Engineering Mathematics is given in Chapter III, we continue with the Mathematics Department under Professor DeLong.

Miss Claribel Kendall began her long connection with the University as a student, receiving the B.A. and B.E. degrees in 1912 and the M.A. degree in 1914. She was a native of Colorado and could tell many stories of excursions on the narrow gauge railroads of the state. Except for her leave of absence in 1920-21 to complete her graduate work at the University of Chicago, she taught continuously at the University of Colorado beginning as an assistant in 1912 until her retirement in 1957. In 1921 she received a Ph.D. degree from the University of Chicago, writing her thesis under Professor Wilczynski on "Congruences Determined by a Given Surface" published in the *American Journal of Mathematics* (Vol. 45), 1923, pp. 25-41.

In 1916 Dr. George H. Light came to the University as instructor in mathematics, was made professor in 1920 and served 27 years until his retirement in 1943. He received his B.A. and M.A. degrees from Princeton in 1899 and 1900 respectively and his Ph.D. from Yale University in 1916, with a thesis on "The Dependence of the Topography of Envelopes of Systems of Extremals on Curvature".

Light was not only involved with the Colorado Mathematical Society and the Rocky Mountain Section of the Mathematical Association of America but was active in civic affairs. The Town and Gown Club of Boulder was founded as a result of a gathering at his house on October 24th, 1925 and he continued to be in charge of this club until his death on October 2, 1953. He participated in various other organizations including the Country Club and Chautauqua Board, and was much interested in baseball, track and golf.

One undergraduate who later made a name for himself in mathematics was Homer V. Craig, who received his B.A. degree from the University in 1924. (His grandfather, Christopher Harvey, came to Denver by horseback from Oregon in the late 1850's and Craig was born in Denver in 1900.) Craig went on to receive his Ph.D. degree from Wisconsin in 1929 and thereafter taught at the University of Texas, Austin, until his retirement in 1970. He now makes his home in Del Rio, Texas.

II

The Department under Aubrey Kempner 1925-1949

In 1925 DeLong retired and Aubrey J. Kempner became Head of the Department of Mathematics. Kempner, born in London, received his Ph.D. degree at the University of Göttingen in 1911 under Edmund Landau, writing his thesis on Waring's Problem. That same year he went to the University of Illinois as assistant professor. One example of his mathematical activity there is noted in Ross Honsberger's "Mathematical Gems", volume 2 (Mathematical Association of America, 1976): "A. J. Kempner of the University of Illinois proved that if from the harmonic series one deletes all the fractions containing a digit 9, the series *converges.*"

Kempner was very active in the mathematical societies of this country, being coeditor of the Transactions of the American Mathematical Society from 1921 to 1935 and a member of its council from 1925 to 1927. In the Mathematical Association of America he served as vice-president in 1927, 1928 and 1935 and was president for the two year period 1937-1939. From 1924 until the end of his presidential term he was one of the three associate editors of the *American Mathematical Monthly.* Burton Jones remembers that while he was associate editor under Walter B. Carver, they received once each month a complete set of galley proofs read by Kempner; many of his comments and corrections were different from all others received. He remembers seeing Kempner frequently at national meetings on close terms with the leaders of American mathematics. (He also found in later years a letter from Kempner written shortly after he had received his Ph.D. degree at Chicago, inquiring about the results of his thesis.) In a very real sense, as far as "The Mathematical World" was concerned Kempner *was* the University of Colorado.

From the beginning, Kempner and Hutchinson (see chapter III) were close friends. Mrs. Hutchinson recalls that they invited the Kempners over to their Thanksgiving dinner shortly after their arrival. One reason for their closeness was that Hutchinson spoke German well. They collaborated on the graduate program and most of the early theses were signed by both of them. One can imagine how they would have worked together on arrangements for the 1929 summer meeting in

Boulder of the American Mathematical Society and the Mathematical Association of America. It was the farthest west these societies had met since 1915 when there had been a special meeting at the University of California. (As a matter of fact the mathematics of this country was centered in the East. The national summer meetings alternated between the "East" and the "West"; for example, the "western" meeting in 1931 was held in Minnesota. Jones remembers that in the early thirties on a trip up the Hudson from a meeting in New York City, he told Professor Julian Coolidge of Harvard University that he was teaching at Cornell and he had the impression that Coolidge knew vaguely that Cornell was in the far west where Virgil Snyder was.) Though the invitation for the meeting must have come primarily from Kempner, certainly Hutchinson, as chairman of the recreation committee, would have made most of the local arrangements. There were 109 members of the American Mathematical Society in attendance and 121 of the Mathematical Association of America (with of course some overlap). R. L. Moore gave the colloquium lectures on "Point Set theory". Virgil Snyder gave the retiring presidential address and the maximum (five) number of papers were given by H. S. Vandiver, mostly on cyclotomic fields. There was an excursion over Fall River Pass and an evening at University Camp (now the Mountain Research Station of the Institute of Arctic and Alpine Research.) Kempner presided for informal speeches including some reminiscences of Professor Emritus DeLong. Some of those who attended the meetings camped in Boulder Municipal Camp which is now Eben Fine Park. (The account of this meeting in the *American Mathematical Monthly* of 1929 makes interesting reading.)

During the period 1925-1949 the number of students in the College of Arts and Sciences increased from 1,675 to 5,311 and the total number on the Boulder Campus from 2,768 to 10,111. In 1924-1925 the faculty from instructor through professor were about 320 in number while in 1948-1949 the number from assistant professor through professor was about 500. In 1925-1926 there were four full-time members of the department: Professors Kempner and Light, Assistant Professor Kendall and Hazard, an instructor (see below). Each year through 1948-1949 there were three or four members of the department of professorial rank. It was the number of instructors and part-time instructors (or teaching assistants) that increased.

In the year 1924-1925 the elementary courses included History of Mathematics, Calculus, Investment, Statistics, Differential Equations, and Theory of Equations. The graduate courses included: Astronomy, Calculus of Variations, Complex Variables, and Introduction to Mathematical Physics. For the year 1948-1949 the undergraduate courses offered were about the same. Some of the new graduate courses were: Theory of Numbers, Algebraic Geometry, Group Theory, and Modern Operational Calculus.

In 1924, William J. Hazard became an instructor in the department. He had received his E. E. degree at Colorado School of Mines in 1897 and since 1918 was a member of the Electrical Engineering Department of that institution. He remained

in the department until his retirement in 1941. He often taught in Denver Extension and in 1942-1943 was in the Applied Mathematics Department.

In 1926 Frances C. Stribic joined the department as an instructor. She had received her bachelor's and master's degrees from the University of Nebraska in 1920 and 1921, and completed all of her work there for a Ph.D. degree except the thesis. She was Chairman of the Mathematics Departments at Buena Vista College, Iowa, and Wilson College, Pennsylvania, before coming to Colorado. Since the department lacked anyone really interested in teaching courses in statistics, she prepared herself in this subject and not only taught it for a number of years, but applied it to some problems in extra-sensory perception in collaboration with Professor Dorothy Martin of the Psychology Department. Using the cards developed by Rhine at Duke University, they performed many experiements here and published four articles (the last running to 159 pages) in the *Journal of Parapsychology* from 1937 to 1940. Much of their data has since been studied by others as well and they all arrived at the tentative conclusion that certain persons have the ability to guess cards with an accuracy not explanable by chance alone. She was an outstanding teacher and was respected by students and faculty alike. She has lived in Boulder since her retirement in 1965.

In 1939, two persons received their Ph.D. degrees. One was Mrs. Marjorie Beaty who is mentioned in Chapter VI and IX. The other was (see Chapter VI) Miss Louise L. Johnson (now Mrs. Robert A. Rosenbaum) who came to Boulder at the age of ten, attended what was then still called "Prep", i.e. the High School, and taught part-time and full-time as a graduate student until she received her degree. She knew that she had no future here since Kempner told her that there were enough women already in the deparment. From here she went to Reed College first as a Fellow under a program for college teachers under Professor Griffin. While there she and Robert A. Rosenbaum were married and together they continued at Reed College until 1953 when they left for Wesleyan University in Connecticut. The Rosenbaums, having interests in Boulder, visited Kempner many times before and during the years of his retirement.

From 1925 to 1949 there were also some undergraduates who later became well known in the mathematical world. One was Donald C. Spencer, born in Boulder and a recipient of a B.A. degree here in 1934. He went on to receive his Ph.D. degree in 1939 from Massachusetts Institute of Technology and an honorary doctorate from Cambridge University in 1963. He received the Bôcher Prize in 1948. From 1942 onward he occupied positions alternately at Stanford and Princeton Universities. At the latter institution he was Henry Burchard Fine Professor of Mathematics from 1972 until his retirement in 1978. A member of the National Academy of Sciences, he now lives in Durango, Colorado.

Another native of Boulder is William J. LeVeque who received his B.A. degree here in 1944. He went on to earn a Ph.D. degree at Cornell University in 1947. The following two years he was a Benjamin Peirce Instructor at Harvard University. He was a member of the department at the University of Michigan until 1970 and,

after six years at the Graduate School at Claremont, became in 1977 Executive Director of the American Mathematical Society.

In 1934 M. Leslie Madison wrote a master's thesis on "Number Systems" under Kempner. He was born in Longmont and had received his B.S. degree in 1931 from what is now Colorado State University to which he returned in 1935 and taught until his retirement. He was chairman of the department there from 1956 to 1969 and briefly later. After retirement he continued to make Fort Collins his place of residence.

The early years of the thirties brought the Depression. Salaries were cut by 10% but prices were low. A number of men in the town took to the hills to make a bare living by working mining claims, grubstaked by Valentine's Hardware Store. These were hard days for the students and toward the end of the decade the University's support from the legislature was so meagre that closing down became a distinct possibility. But in many ways the life of the University must have gone on much as before. Forty years later Purcell recalled "unforgettable evenings with Professor and Mrs. Kempner at their home during my two years as a graduate student in Boulder". On May 15, 1939, Kempner gave the first Research Lecture on a mathematical subject in the series sponsored by the Council on Research and Creative Work of the Graduate School. Before the lecture a dinner was given in "The Gold Room" in his honor with 47 persons in attendance, paying 75 cents a plate. (The Council made a profit of $1.80 on the transaction. The Gold Room was probably in what is now the Economics Building.) To date there have been only two other members of the department honored in being selected to give such a lecture: Chowla, who in 1957 talked on "Thoughts on Number Theory", and Ulam in 1971 on "The Brain, Mathematics, and the Physical Universe."

In 1946 Albert B. Farnell was appointed to an assistant professorship in the department. He had received his Ph.D. degree at the University of California. He was a member of the department until 1951 except for the year 1948-1949 spent as a lecturer at Princeton. After leaving Colorado he had positions with aviation companies until 1963 when he accepted a professorship at Colorado State University, where he now is.

In 1943, shortly after DeLong's death, it was found that he had left a bequest to the University for the benefit of the Mathematics Department. It was in the amount of $25,000 (almost seven times his maximum yearly salary), but this was reduced to $12,750 to provide for supplementary income to his daughter, Mrs. Ruth Elizabeth Avery. So the balance was invested in government bonds to accumulate interest until the original amount was restored. In 1962 the department began to receive the income from this bequest to be used as the "President of the University of Colorado and the acting head of the Department of Mathematics . . . deemed advisable . . . to promote studies in mathematics, or for such other purposes as may seem most worthwhile to the individuals above named, as changing conditions might bring about, desiring to give to those individuals the widest and freest discretion in the choice of objects for which this fund may be used." Rumor

was that he had in mind money for readers, but he was wise enough not to restrict funds to that purpose. The Mathematics Department in consultation with the President of the University, Quigg Newton, decided to use the bequest for an annual series of DeLong Lectures, bringing distinguished speakers to the department, and prizes for undergraduate students. Professor Paul Halmos was the first DeLong Lecturer. The list of lecturers to date is given in the Appendix.

In 1948, Burton W. Jones was appointed to a professorship in the department. He had received his Ph.D. degree at the University of Chicago in 1928, writing his thesis under Leonard E. Dickson. He had taught in the Mathematics Department of Cornell University from 1930 until his appointment here. He assumed the chairmanship upon Kempner's retirement in 1949 and remained in that capacity, with two years of absence, until 1963 when he was succeeded by Arne Magnus.

In 1949 the mathematical societies had their second summer meeting in Boulder with 770 adults registered. There was an excursion in the fog over Trail Ridge Road (much less rigorous than the old Fall River Pass which now has one-way traffic in the summer) and the "Steak Fry" was held on Flagstaff Mountain. Again Hutchinson was chairman of the arrangements committee. [In contrast, the third summer meeting in Boulder, in 1963, was attended by 1,302 registered members and their families and the "Western Beef Barbecue" was held in the quadrangle near the residence halls. By then the University was much more experienced in handling summer visitors and the faculty could concern themselves more with the mathematical aspects of the program.]

After Kempner's retirement he taught for a year as visiting professor at Pomona College before returning to Boulder. He gave occasional courses in the Medical College at Denver and the National Bureau of Standards as well as in the Mathematics Department. The Kempner Colloquium was named in his honor (See Chapter IV). He lived in Boulder until shortly before his death in 1973.

Aubrey J. Kempner
(University of Colorado Photo)

Claribel Kendall
(From The Daily Camera, Boulder)

Charles A. Hutchinson
(University of Colorado Photo)

Jack R. Britton
(University of Colorado Photo)

III

The Department of Applied Mathematics

In 1906 the population of Boulder was about 12,000, a figure which changed only slightly up and down until 1940. The University had 840 students and fourteen buildings including "Ladies Cottages 1 and 2". The trees were mere saplings. The railroad ran along what is now Canyon Boulevard. At that time the narrow gauge railroad on the so-called Switzerland Trail took students, townspeople, and sometimes a piano on excursions to Monte Alto Park. The automobile was just coming into use. In short, many fundamental changes were taking place.

Two years before, Milo S. Ketchum had come from the University of Illinois to become head of the Civil Engineering Department of the School of Applied Science and in 1905 was made dean of that school. So in 1906, as noted in Chapter I, the College of Engineering was formed with Professor Ketchum as its dean. The Mathematics Department was divided in two and Saul Epsteen became head of the Department of Engineering Mathematics of the new college, assisted by two senior students. The Regents generously allotted $100 for the new department—presumably for supplies.

Most of the undergraduate courses under Epsteen were pretty much the same in title as those in the LIberal Arts Department, one exception being a course in Least Squares for 1910-11. But in 1907 Epsteen wrote a text in Engineering Calculus; hence probably the content of courses in the two departments differed. They worked together on graduate couses. During his term two such courses clearly reflected his interests: Hypercomplex Number Systems and Continuous Groups. Also mentioned was a course in Applied Higher Mathematics.

A description of Epsteen's previous career is given in Chapter I. The student editor of the 1912 Coloradoan Yearbook wrote of Epsteen: "He has solved all equations save the feminine". One wonders if the editor knew that in 1911 Epsteen had married Emily Wood. We have rather scanty information about his career after he left the University in 1913. He was Insurance Commissioner of the State of Colorado for one year. The year after, he became a Fellow of the American Institute of Actuaries and is listed in its yearbooks through 1931, but not in 1932. He was in banking in various parts of the state; for instance, in the 1921 edition of American Men of Science his address is given as the First National Bank of La Jara.

He appeared at meetings of the Rocky Mountain Section of the Mathematical Association of America in 1923 and 1930 though not listed as a member; at the former he gave a talk on the Einstein Theory. His wife taught courses entitled "Children's Books" in the summer school of 1938 and some years before and after. She gave many children's books to the University Library which may be found in the Rare Books Room under the title of the Epsteen Collection.

Succeeding Epsteen was Joseph Morrill who was assistant professor of engineering mathematics from 1913 to 1915, receiving a degree of Electrical Engineer in 1914. After teaching one more year in Electrical Engineering he went into industry.

In 1913 Charles Sperry was an instructor in engineering mathematics and succeeded Morrill as head of the department in 1915. After being in this post for one year he was promoted to an assistant professorship at a salary of $1400. He received his B.S. degree in Civil Engineering at the University in 1911 and the degree of Civil Engineer in 1915. He was the son of Rear Admiral Charles Stillman Sperry who was the commander of the U.S. battleship fleet on the second part of its cruise around the world from 1907 to 1909. This was Theodore Roosevelt's "Great White Fleet" sent to impress the powers of the world with the might of our navy and to call attention of the citizens of the United States to this branch of our armed forces.

While at the University, Sperry worked closely with Dean Ketchum on a number of pioneering and widely used books in the field of engineering. Perhaps their most significant work was "The Structural Engineer's Handbook" published in 1914. In 1916 the Journal of Engineering of the University published Sperry's text: *A Preliminary Course in Differential Equations.* The number of copies printed was 1500 and the price, thirty-five cents. There were few changes in departmental offerings during his tenure except for courses listed in the Theory of Measurements and The Mathematical Theory of Heat. Sperry was in poor health during the latter part of his tenure, taught only part-time beginning in 1921 and died in 1924. After his death his mother gave his impressive mathematics library to the University.

In 1918 Charles A. Hutchinson came to the Department of Engineering Mathematics as an instructor at a salary of $1200. He had received his B.A. and M.A. degrees from Wittenberg College, Ohio, in 1916 and 1918. At the age of twenty he was one of those attending the meeting at Columbus, Ohio, in December of 1917 when the Mathematical Association of America was born. The chief influence that brought him to Colorado were his teachers of German and French at Wittenberg College who left Ohio for Boulder in 1916. (Apparently they did not teach at the University.) Though he visited neither France nor Germany he seems to have been quite fluent in both these languages and, as was noted in the previous chapter, his knowledge of German was one of the early factors in his close relations with Kempner. His arrival in Boulder coincided with the onset of the influenza epidemic which brought about the closing of the University until November twelfth. Hutchinson remarked: "I arrived on Sunday, went to work on Monday, was locked out on Wednesday. It was a glorious autumn and an opportunity to get acquainted

with the hills—on foot of course." As Sperry's health failed, Hutchinson took over increasing responsibility in departmental affairs and on Sperry's death became professor and head of the department. He held this position for 36 years. Apparently he and Sperry were very close friends. Hutchinson's son Thomas, who received his master's degree in 1951 under Britton, was given his middle name in honor of Mrs. Sperry, his godmother.

Though Hutchinson had no Ph.D. degree, his knowledge was broad and deep in many fields. From 1918 until he became head of the department, he was listed as a graduate student in various combinations of mathematics, physics, and astronomy. From the beginning, at the graduate level, the demarkation between "pure" and "applied" mathematics was not at all clean-cut, though there were certainly differences in points of view. For instance, in 1927 Kempner gave a couse entitled "Advanced Mathematics for Modern Theories of Physics" and Hutchinson offered courses in real and complex variables.

With Hutchinson's leadership many new courses with a distinct applied flavor were added. In 1923-24 for instance, new undergraduate courses included: Geodetic Surveying, Mathematical Theory of Heat Conduction, Least Squares, Practical Astronomy, Nomography, and Slide Rule, as well as Advanced Calculus and Infinite Processes. Graduate courses in the same year included: Calculus of Variations, Introduction to Mathematical Physics, and Potential Theory. Later in catalogues the departments gave themselves more leeway by the words "courses to be announced".

Though Hutchinson was not as active on the national mathematical level as Kempner, he was an associate editor of the *Mathematical Monthly* from 1938 to 1941 in charge of the department on mathematical education. The first three contributors to his department were Earl Raymond Hedrick, G. Baley Price, and Richard Courant. As was noted previously, he was in charge of local arrangements for the summer meetings of the mathematical societies in 1929 and 1949. He served as Governor of the Rocky Mountain Section from 1954 to 1957. In fact, into the early 1950's the Rocky Mountain Section was largely run by the heads of the departments at Boulder, Fort Collins, Laramie (Wyoming), Greeley, and Denver, along with Colorado College represented by Cajori and Sisam in the early years. It was the custom for the heads of the departments to have breakfast together on the Saturday morning and decide on what would be considered at the business meeting later in the day. At his first meeting of the Rocky Mountain Section in 1949, Burton Jones was invited to the "traditional party" the Friday evening after the banquet in Hutchinson's motel room with other members of the mathematics departments in Boulder and elsewhere; he remembers that they indulgently provided him with a soft drink since he was not *then* a "drinking man". For years the Applied Mathematics Department, usually under the direction of Robert Ellingwood, took the initiative in arranging for a bus to take people to the meetings. As a result those from the University of Colorado were much in evidence at section meetings. In fact, it was hard to achieve much representation at the national meet-

ings. (Nowadays it is the other way around.)

For a number of years Hutchinson was a mathematics editor for Harper Brothers and on an occasional basis for Macmillan Company. One of his favorite remarks was that he could open any mathematics book at random and find an error on the page. He was one of the founders of the Rocky Mountain Rescue Group in which he was active most of his life.

Hutchinson ran a very tidy department in which the syllabi for the elementary courses were very detailed and the day-to-day assignments specified, corrected promptly and returned, usually by the teacher. The chief emphasis was on good teaching which Hutchinson evaluated by consideration of comments of students and part-time persons, students' performances in later classes, and in common examinations in the many-sectioned courses. The normal teaching load was 12 to 15 hours a week with occasional reduction of load for the teaching of new or advanced courses or for graduate study.

Until 1960 most of the members of the department had engineering degrees and stayed for relatively short periods of time. However, four served for many years. Walter K. Nelson (B.S. and E.E., University of Colorado, 1916 and 1922) began as an instructor in 1919 and remained until his retirement in 1959. Alan S. McMaster (C.E. in Civil Engineering, University of Texas in 1914 and M.S. in Civil Engineering at the University of Colorado in 1927), was in the department from 1924 to 1946. Ernest P. Tovani (B.S., University of Colorado, 1922; E.E. in 1927) was a member of the department from 1925 to 1959. The longest tenure was that of L. Clifton Snively, born in the mining town of Sunshine, Colorado (B.S. and M.S. in Electrical Engineering, University of Colorado, 1928 and 1929) who was a member of the department from 1929 until his retirement in 1973. During this period he took a number of graduate courses and served on many Ph.D. examination committees in Civil and Electrical Engineering.

In this period there were some who stayed only a short time but who became well-known elsewhere. Ross R. Middlemiss received his B.S. degree in Engineering in 1926 and his M.S. degree in 1929. His master's thesis: "A comparative study of methods of summing divergent series" appears to be the first that Hutchinson directed. He was an instructor in the department from 1926 to 1929 after which he went to Washington University from which he retired in 1969. He wrote a number of college texts and was a pioneer in teaching mathematics by closed circuit television. He now lives in Canon City.

Ivan Hebel, who taught in the department from 1924 to 1926 received the degrees of B.S. in Chemical Engineering and M.S. in Chemistry from the University in 1922 and 1934 respectively. After one year at Missouri School of Mines he went to Colorado School of Mines where he remained until his retirement in 1963; the last fourteen years he was head of the Mathematics Department. After his retirement he taught eight years at Denver University where he still teaches on occasion.

In 1929 Earl D. Rainville came to the University of Colorado. He had not been able to complete his work for the B.A. degree at Clark University because of poor

health. The year after his arrival he corrected papers for Hutchinson and completed his work for a B.A. degree. He was an instructor in the Engineering Mathematics Department from 1930 to 1933 and he seems also to have taught on a part-time basis in the other department. He was in the Bureau of Reclamation in Denver from 1933 to 1937 while continuing his graduate work in the departments, culminating in a master's degree in 1935 under Hutchinson's direction—"On the conduction of heat in concrete dams". He received his Ph.D. degree at the University of Michigan in 1939. In 1937 he began a distinguished career in the University of Michigan which lasted until his death in 1966.

There were four short-term members of the department who later received Distinguished Engineering Alumnus Awards for their leadership in the academic and business worlds. Elsie Eaves was an instructor in the department in the years 1919-21. "As the lively and perceptive manager of the Business News Department of Engineering News-Record she was instrumental in developing the construction activity reports and their statistics, wage and price cost indexes and special cost issues of ENR into resources used by construction people and manufacturers to forecast business trends." She was the first woman to receive many awards including this one. Frank W. Stubbs was in the department from 1920-23. At Purdue University where he taught from 1947-1967 he developed a graduate program on construction and served as university liaison with the Associated General Contractors. Marion E. Dice, instructor in the department for 1922-23, later developed the "Dice Equation" for computing the pressure at any depth in an oil or gas well from measurements made at the surface. For twelve years he was a member of the Executive Committee of the Board of Directors of General Petroleum Corporation (now Mobil Oil Company). Frank L. Carswell, instructor for the year 1923-24, became a heavy construction expert. His former companies built the nation's largest international trade zone in the United States, located in Kansas City, Missouri, which uses as storage space underground chambers hollowed out in mining for aggregate. The first two taught for one year when they were seniors. Murray Skinker, an instructor in Engineering Mathematics from 1919-21 (B.S. and M.S. in Engineering in 1919 and 1921 respectively) is distinguished by having been a Rhodes Scholar from 1921 to 1924.

In autumn of 1929 Jack R. Britton arrived in Boulder. He and Rainville had been close friends at Clark University where Britton had just received his B.A. degree. The two had arranged to share an apartment and when Rainville told him there was an opening in the Engineering Mathematics Department, Britton promptly went to see Hutchinson and was appointed to an instructorship. He was naturalized in 1932, having been born in St. Petersburg. Along with his teaching he continued his graduate work culminating in a Ph.D. degree in 1936 under Kempner's direction. He remained in the department until 1966 (see later in this chapter). In 1954, G. McCrossen and L. D. Rutland received Ph.D. degrees under his direction and in 1956, R. G. Buschman and J. R. Hanna. Britton collaborated with Sniveley on a college algebra text and is the author of a number of texts at

higher levels. He was Secretary of the Rocky Mountain Section of the Mathematical Association of America from 1946 to 1953.

The second World War brought many changes to the University. In 1942 President Stearns, involved with the planning of the Navy "V" programs, asked Hutchinson to take charge of these programs at the University of Colorado for one year. Hutchinson arranged to do the enlisting for these programs on the campus until they were merged into the V-12 program the following year. His son Charles was the first to enlist. Hutchinson supervised mathematical courses for the pilot training and pre-radar groups under the Civil Aeronautics Administration. In the 50's he directed classified research for the navy and air force, and was later recognized by the navy with a certificate for meritorious service. On top of heavy enrollment in mathematics as service courses, five members of the department (in many cases doubling their teaching loads) taught such courses as Analytic Mechanics, Direct and Alternating Current Circuits, Thermodynamics, and Mechanical Vibrations for most of the engineering program. More than 6000 students were instructed in an accelerated three-term system.

In 1946 Karl Stahl (B.S., Colorado State University, 1924; M.S., Ph.D., Pittsburgh, 1933, 1939) joined the Engineering Mathematics Department. He made use of his previous experience to do some pioneering work in High School visitation and in student counselling for the College of Engineering.

That same year, Leon F. Rutland came as an instructor. He had received his B.S. and M.S. degrees from the University of East Texas in 1940 and 1941. Except for a year's leave of absence in 1947-48 he remained as an instructor until he received his Ph.D. degree in 1954 under Britton. (It was a rule of the University that no one at a rank higher than that of instructor could receive an advanced earned degree from this institution.) Then he was promoted to an assistant professorship and remained with the department until 1963 when he left to become head of the Mathematics Department at Virginia Polytechnic Institute in Blacksburg.

John F. Wagner (M.S. in Engineering, University of Colorado, 1933) came to the department as an instructor in 1947, was promoted to an assistant professorship the following year and remained until his retirement in 1967.

In 1948 the name of the department became the Applied Mathematics Department and Master of Science degrees were authorized in the subject. Previous to this time Hutchinson had directed at least eight master's theses, sometimes in collaboration with Miss Kendall or Kempner. With the exception of Rainville's thesis, previously mentioned, and one on "Methods for the determination of orbits in theoretical astronomy," all were on subjects generally considered "pure" mathematics. From 1948 until 1959 one or two Master of Science degrees were given each year.

In 1952 Robert W. Ellingwood (M.A., Illinois, 1948) and Roy Ben Kriegh (M.A., Nebraska, 1950) joined the department as instructors. In 1954 the Applied Mathematics Department established a Computing Laboratory—at that time the only such facility in the state. In 1956 Stahl became Assistant Dean of the College of Engineering to work with new students.

In 1957 there was approved a program leading to a B.S. degree in Applied Mathematics. Britton was put in charge of the graduate work, Stahl the calculus courses, and Hultquist and Rutland directed the undergraduate program. In the beginning, twelve or fifteen qualified seniors were engaged as part-time instructors to assist. In 1960 materials were written for lower division mathematics culminating in the two-volume text *University Mathematics* (Freeman and Company) written by Britton, Kriegh and Rutland. Hutchinson, Rutland and Varner collaborated on a book entitled *Engineering Problems.*

In 1960 Dean Eckel retired and Hutchinson was appointed interim Dean of the College of Engineering. This marked the beginning of radical changes in the Applied Mathematics Department. One year before, there had appeared the report of the Committee for the Study of the College of Engineering. The committee noted the need for graduate courses in the College, partly to meet the needs of industry, and the scarcity of faculty qualified to give them. It was pointed out that a large proportion of the faculty had received their highest degree (B.A., M.A. or M.S.) from the University of Colorado, and it recommended strongly that "distinguished professors" be brought in from outside to support a viable graduate program. Furthermore, the members of the committee felt that, while the normal twelve hour teaching load was "reasonable for undergraduate teaching", it did not leave time for giving graduate courses and directing theses. Britton became acting head of the Applied Mathematics Department in 1960 and during the next two years, Provost Oswald Tippo informed him that his department could not continue as it was and that he must recruit qualified faculty with Ph.D. degrees.

It is of some interest to note that W. Reese Turner (B.S. from M.I.T. in 1953 and M.S., University of Colorado in 1956), who was an assistant professor in the department from 1960 to 1962, received his Ph.D. degree in Electrical Engineering at Stanford University in 1961. He went on to Hewlett-Packard Company in California.

Dr. Max Peters became dean of the College of Engineering in 1962, Hutchinson became Associate Dean, and Britton Chairman of the Applied Mathematics Department. (Heads for indefinite terms were being replaced throughout the University by chairmen with definite terms of office.) At this time a Ph.D. degree in Applied Mathematics was authorized and the first such degree was awarded in 1964 to R. B. Guenther under Fulks' direction. Dean Peters emphasized more strongly to Britton the need for new members of the department with Ph.D. degrees and informed those without such degrees that they should begin work toward them. In the Fall of 1962, Irving Weiss was appointed to an associate professorship; he had received his Ph.D. degree from Stanford University in 1955. At that time also five were appointed to assistant professorships: Jerrold Bebernes who received his Ph.D. degree from the University of Nebraska in 1962, George Clements who received the same degree in the same year from Syracuse University, Wayne Smith in Numerical Analysis who received a Ph.D. degree from UCLA in 1958, Kasturi Arora who was the first to receive his Ph.D. degree under the direction of Eberhard Hopf at the

University of Indiana, and Robert Kuller who received his Ph.D. degree from the University of Michigan in 1955. The first two are today in the department. Wayne Smith remained only one year and Kuller and Arora for three and four years respectively. The normal salary in those days for a new assistant professor with a doctor's degree was $8000 and the teaching load was 9 hours.

There were three additions to the department in 1963: Professor Watson Fulks (Ph.D., Minnesota in 1949) from three years at Oregon State University; Associate Professor Gary Meisters (Ph.D., Iowa State University in 1958) and Assistant Professor Eugene Rex Krueger (Ph.D. Rensselear Polytechnic Institute in 1962). Krueger became Director of the Computing Center in 1967 and left Colorado in 1974 to become Vice-Chancellor of the Universities of Oregon.

In 1964 George Milton Wing (Ph.D. Cornell University, 1949) was appointed to a professorship; he left two years later for the University of New Mexico. That same year William B. Jones (Ph.D. Vanderbilt, 1963) was appointed to an assistant professorship.

Research contracts were coming into being during this period and three members of the department had contracts with the National Science Foundation: Fulks for Partial Differential Equations and Asymptotics, Krueger for Stability of a Spiral Fluid Flow, and Milton Wing in Differential and Integral Equations. Krueger's research grant included funds to support Bebernes and Meisters in their fields.

The department also had its share of summer institutes supported by the National Science Foundation. In the summers of 1957 and 1960 Hutchinson directed seminars in Applied Mathematics under the auspices of the American Mathematical Society. Rutland directed an institute for ninth grade teachers in 1962 and in 1965 Britton directed one on Mathematical Analysis of Chemical and Physical Systems for College Teachers ($40,040). Ellingwood was in charge of the local arrangements, including excursions, for these institutes, for the AMS/MAA summer meeting in 1963, and many others; he was very effective in this capacity.

Hutchinson received many honors including the Robert L. Stearns award in 1959 (Stahl received the same award in 1969) and the Outstanding Teaching Award of the Alumni Association in 1964. He participated with his usual vigor in the inauguration of closed television instruction before and after his retirement in 1966. In fact after his "retirement" he taught classes in the University and neighboring institutions. He was Director of Engineering Alumni Relations from his retirement until his death early in 1970 and he received posthumously the Distinguished Engineering Alumnus Award in June of that year.

From the beginning until the time when the departments combined in 1965, the primary responsibility for planning and staffing extension courses in mathematics was taken by the Applied Mathematics Department. This was natural since until recently most of those taking extension courses were fully employed and were interested primarily in mathematics related to their occupations. There were some extension courses as far back as 1912 but they could not have been very extensive,

judging by what little was offered in 1923 when the first convenient records can be found. In that year Hutchinson gave all the mathematics courses in Denver; there were four of them: Trigonometry, Differential Equations, Solid Analytic Geometry and High School Algebra. This was apparently too ambitious, for the following year there was only one course, Trigonometry, taught by W. J. Hazard, then an instructor in the Mathematics Department in Boulder. This was the most advanced course given until suddenly in 1929-30, Light gave a year course to two students in Functions of Complex Variables, a subject which did not recur there for at least twenty-five years. Most of the advanced courses were given by Hutchinson, such as: Partial Differential Equations (18 students) in 1931-32; Hydrodynamics and Elastic Stability between 1934 and 1937. In 1940-41, for instance, Hutchinson and Tovani gave four courses each and Nelson six.

With World War II, an Engineering Science Management War Training program was initiated. Hutchinson gave a course to 22 students on War-time Applications of Calculus and Britton one in Operational Calculus. Many members of the Applied Mathematics Department taught in Denver but until close to 1960, Hutchinson taught at least as many courses as anyone else. In fact, he continued to teach there after his retirement; two weeks before he died he had asked Sherrill to take two classes for him "temporarily" since he was not feeling well.

In 1946 the volume of extension courses had reached a point where the Denver Extension Division was established and in 1964 it became the Denver Center. Ray Hanna, who had been coordinating the mathematics instruction in Denver, was made vice-chairman of the Applied Mathematics Department in charge of the mathematics there. He left for the University of Wyoming in 1967 and was succeeded by Hightower. In 1972 the University of Colorado at Denver was established with its own chancellor. From that time the department in Denver has been increasingly autonomous though still cooperating on the general graduate program. The present chairman is Charles Sherrill who started teaching in Denver for the Applied Mathematics Department in 1955.

The involvement of the full-time personnel of the Mathematics Department (in the College of Arts and Sciences) was minimal. Zirakzadeh taught two courses for a period of about two years, a number of part-time persons taught there commuting from Boulder, but increasingly those teaching in Denver lived in the metropolitan area.

The first extension course in mathematics in Colorado Springs was one in Algebra in 1931-32 and as late as 1946-47 the only mathematics course taught there was Engineering Mathematics 1, attesting the involvement of the Applied Mathematics Department. The staff consisted mostly then and almost exclusively now of those who live nearby. Some general and specialized couses are taught by those in the mathematics department of the Air Force Academy. The present chairman at the University of Colorado at Colorado Springs is James R. Modeer who taught in the Applied Mathematics Department from 1960 to 1962 and received his Ph.D. degree from the University of Colorado in 1966.

The academic year 1964-65 was a time of increasing unrest in the department, culminating in a strong letter to Dr. Thurston Manning, Vice-President and Dean of Faculties, signed by eight new appointees stating that the position of the department had become untenable and urging the establishment of a new Division of Mathematical Sciences to include both departments of mathematics and the computing center. Following this, Dean Peters arranged, with the department's consent, that it would be run by an executive committee consisting of Fulks, chairman, Kriegh and Krueger. This interim arrangement went into effect on July 1, 1965. Britton remained for one year at the University and at the end of the summer of 1966 left to become head of the Mathematics Department at the University of West Florida. In 1967 he became Professor of Mathematics at the University of South Florida where he remained until his retirement ten years later.

IV

The Growing Mathematics Department, 1949-1965

When Burton Jones became chairman of the department in 1949, there were three other members of professorial rank: Professor Claribel Kendall and Assistant Professors Frances Stribic and Albert Farnell. There were about fifteen part-time instructors including William E. Briggs, who had just received his master's degree and was to become a full time member of the department, and Burrowes and Dudley Hunt. Shortly after Hunt received his Ph.D. degree in 1951 they went to Reed College where they have been until the present day. (Hunt retired in 1977.) Robert L. Stearns was President of the University, there were no chancellors, and just two vice-presidents: W. Farrell Dyde, Dean of Faculties, and Ward Darley, Dean of the Department of Medicine. There were about 10,000 students on the Boulder Campus and the size of the faculty above rank of instructor was about 200; Mrs. Stearns knew most of the faculty wives by name. Over half the students were residents of Colorado, there were 775 from Illinois and 417 from California. The population of the city of Boulder was about 20,000.

At that time there was no typewriter in the department—much less a departmental office and secretary. If one needed to write a letter he typed or wrote it longhand, or, if it was very important, sent it to the University secretary. The department's first secretary, serving part-time, was Florence E. Merrow in 1950-51. It continued to have a part-time secretary until the early 1960's. The deparmental office was 119E Hellems, that of the chairman, until 1959-60 when room 212E became available with an adjoining office for the chairman. In 1963-64 the technical typing needs of the department reached the point where Mae Jean Ruehlman was hired part-time to relieve Verna Bayles, then our full-time secretary.

As mentioned in Chapter II, Farnell left the department in 1951 and in his place Albert Edrei came from the University of Saskatchewan. He had received his Ph.D. degree from the Eidgenössische Technische Hochschule in Zürich in 1940. At the end of the academic year he left for Syracuse University, where he now is.

In 1949, Robert C. Gunning entered the University as a freshman. For at least a year before receiving his B.A. degree in 1952 he was taking graduate courses in mathematics and, to the despair of other students in those classes, surpassing them all. He was a third generation Coloradoan, for his mother and her mother were born

in Colorado and his grandfather Albert H. Gunning bought a farm west of Longmont in 1893. In his father's time it was discovered that the farm was a good source of building clay and is part of the present Colorado Brick Company still in the hands of the family. Gunning was born in Longmont and went to high school there. After graduating from the University he went to Princeton University where he received his Ph.D. degree in 1955. He has been a member of the department at Princeton since 1956, has had a number of leaves abroad, and has been chairman since 1976.

In 1952 Sarvadaman Chowla came to the department as Professor of Mathematics at a salary of $6400, after three years as visiting professor at the University of Kansas. He was born in Cambridge, England, while his father was doing graduate work in mathematics. After receiving his Ph.D. degree there under J. E. Littlewood, in 1931, he returned to India and was Professor of Mathematics at the Government College in Lahore from 1936 until the time of the partition in 1947. He and his family were fortunate to get out with their lives. For the year 1948-49 they were at the Institute for Advanced Study in Princeton. He was on leave of absence from the University of Colorado during the years 1963-65 at the end of which he moved to Pennsylvania State University. Since his retirement in 1975 he has been mostly in residence at the Institute for Advanced Study, which is his present address.

During the academic year 1952-53, Robert G. Osserman was an instructor. He returned to Harvard University where he received his Ph.D. degree in 1955 and thereafter became a member of the Mathematics Department in Stanford University, where he now is.

In 1953-54 William E. Briggs and Walter E. Mientka were the department's first research assistants, being supported by an Air Force Research contract of Chowla's. That same year Edward B. McLeod and Aboul Zirakzadeh were full-time instructors. The latter had just received his Ph.D. degree from Oklahoma State University, and later became a permanent member of the department. The former (Ph.D., Stanford University) left in 1955 and has been since 1964 in California State University at Long Beach.

Miss Kendall continued to play an important role in the affairs of the department. She was Acting Chairman during Jones' leave of absence in 1954-55. She was the first member of the department to receive, in 1957, the Robert L. Stearns Award of the University for "outstanding service or achievement". (Kempner received the same award in 1964 and Jones in 1971.) She was secretary of the Alpha of Colorado Chapter of Phi Beta Kappa from December of 1922 until 1964. The Claribel Kendall Scholarship was established by the chapter in her honor. She was also "second Reader" from 1944 to 1947 in the First Church of Christ Scientist of Boulder and held other offices in this church from time to time. After her retirement she remained in Boulder, living with her sister Florence, until her death in 1965.

In 1954 Wolfgang Thron joined the department as an associate professor. He had received his Ph.D. degree at Rice University in 1943, had taught at Harvard

University (1943-44) and Washington University (St. Louis) from 1946 until coming to Boulder.

Four new assistant professors were appointed in 1956-57: William E. Briggs who had received his Ph.D. degree under Jones in 1953 and was to become Dean of the College of Arts and Sciences in 1964; Arne Magnus who had received his Ph.D. degree at Washington University in 1953 and was a member of the department at the University of Nebraska two years before coming to Colorado; Robert V. McKelvey who had received his Ph.D. degree at the University of Wisconsin in 1954 and came to us from the University of Maryland; and Zirakzadeh, mentioned previously.

In 1957-58 two new members came: Irwin Fischer and Burnett Meyer. The former received his Ph.D. degree from Harvard University in 1953 and taught at Minnesota and Dartmouth before coming to Colorado. The latter received his doctor's degree from Stanford University in 1949 and was a member of the department at the University of Arizona from then until coming to us.

In the period from 1958 to 1966 there were a number of persons appointed who are still members of the department. In 1960-61 there were two: Wolfgang Schmidt (Ph.D., Vienna, 1955), who after a year as research associate at Columbia University and two years as docent in Vienna, returned in 1964; and John H. Hodges (Ph.D., Duke University, 1955). In 1961-62 there were also two: Ruth Rebekka Struik (Ph.D., New York University, 1955) who later taught at the Denver and Colorado Springs Centers before returning to Boulder, and David Rearick (Ph.D. California Institute of Technology, 1960). Donald Monk (Ph.D., University of California, Berkeley, 1961) joined the department in 1962. In 1963-64 there came William B. Jones, who the following year moved to the Applied Mathematics Department, and Richard L. Roth (Ph.D., University of California, Berkeley, 1963).

In this same period there were some who moved elsewhere after being with us for a period of time. One was Charles W. Austin (Ph.D. University of Washington, 1962) who left in 1966 for California State University at Long Beach. Another was James Moser (Ph.D. in Education, University of Colorado, 1965) who came as a joint appointee with the College of Education in 1965. He was on leave for the year 1969-70 and then left for the University of Wisconsin. That same year (1965) came Collin J. Hightower (Ph.D., Tulane University, 1965); in 1966 he moved to the Denver Center where he now is. There were three who stayed for only one year: (1960-61) Marguerite E. Dunton (a student of Chowla's) now at California State University at Sacramento, (1962-63) John H. Halton now in the Computer Science Department of the University of Wisconsin, and (1963-64) Richard P. Goblirsch now at the College of St. Thomas in St. Paul.

In the administration of the department, responsibility for library acquisitions was rotated among a few of its members. In those days most of the department's business was conducted as a committee-of-the-whole so to speak, a procedure which continued until 1963. The recommendations for admission of graduate students, recipients of fellowships, appoinments of part-time instructors, and decisions on

courses to be offered and by whom were made by all the professorial members of the department. When a prospective new member came to see and be seen, he usually was given a tour of the environs by the chairman or his wife and lodged in their home. The University footed the bill for a departmental luncheon to meet the candidate and he was invited to give a talk at the colloquium. After his departure, the department met to decide whether to give him an offer and what to ask from the administration; often the more experienced instructors and graduate students were consulted informally. The chairman received $200 extra for the academic year toward reimbursement for official expenses. (This was literally construed to the extent that if he should be on leave for the summer, $50 was taken from his salary to grant to his temporary replacement.) Though the University of Colorado was becoming better known, we had to reckon with the fact that we were not on the top of the list for most prospective graduate students and a number of our candidates for full-time positions were skeptical about the future of the department.

Though government support of basic research may be said to have begun on an organized scale almost immediately after World War II, it received new impetus with the establishment of the National Science Foundation in December of 1950. (See, *Science the Endless Frontier* republished by the National Science Foundation in 1960.) In 1952, Professor Marston Morse as Chairman of the Mathematics Division of the National Research Council, appointed a Committee on the Regional Development of Mathematics to advise Dr. Harry C. Kelly, Assistant Director of Scientific Personnel and Education of the National Science Foundation. The members of the committee were Professors Baley Price of the University of Kansas, William L. Duren of Tulane University (later the University of Virginia), Carl B. Allendoerfer of the University of Washington, Burton Jones of the University of Colorado and William Whyburn of the University of North Carolina. The committee was asked "to study the effect of mathematics on the smaller graduate schools, the NSF fellowship program in mathematics and the grants-in-aid and research contracts with NSF, Office of Ordnance Research, and Office of Naval Research." The main initial activity of this committee was to give advice for the establishment and conduct of summer intitutes for college and secondary school teachers of mathematics. Later it was instrumental in setting up the Committee on the Undergraduate Program in Mathematics.

Before the National Science Foundation entered the field of institutes there had been others: those in Physics supported by the General Electric Company and Dr. R. W. Rankin's series of short-term mathematics institutes from 1941 to 1952 at Duke University. The first summer institute supported by the National Science Foundation was held at the University of Colorado in the summer of 1953, for college teachers of mathematics. (See *An Investment in Knowledge*, New York University Press, 1969, p. 119 ff.) The total budget was $12,750. This included stipends of $300 each for about 20 participants (many came without stipends), salaries and travel expenses of lecturers, (nothing for the director, Burton Jones), paper and secretarial help. Much of the running of the ditto machine was done by

Mrs. Artin and her daughter, who later became Mrs. John Tate. The principal lecturers for the entire eight weeks were Professors Emil Artin of Princeton University and R. L. Wilder of the University of Michigan. The following appeared for a week each: Dr. George Polya of Stanford University, Dr. Eugene P. Northrup of the University of Chicago and Dr. Carroll V. Newsom, associate commissioner of education of the state of New York. Professors Robert E. Stoll, then of Oberlin College, and Daniel Christie of Bowdoin College were the assistants of Artin and Wilder, respectively. There were 81 participants, 48 of whom lived in Cockerell Residence Hall with their families along with the lecturers and their assistants. One of the excursions of the group was to tour Los Alamos.

From the early 1950's profound changes were taking place in Boulder. The first staff of the National Bureau of Standards arrived in mid-1951 and the toll road to Denver opened the following January. What is now Ball Brothers Research Corporation started as Control Cells Corporation in 1954. Beech Aircraft Corporation installed itself north of Boulder, in 1956, NCAR (The National Center for Atmospheric Research) on the mesa in 1960 and IBM on the Longmont diagonal in 1965.

In 1900 the city had obtained from the federal government 1800 acres of parkland including the top of Flagstaff Mountain and some of Green Mountain. From 1906 to 1920 it had acquired more land in the vicinity from the state and federal governments. In 1921 the city purchased land in the areas of the Red Rocks and Flatirons to prevent further development of quarries in those areas. But there was no further acquisition until 1958 when there was a proposal to build a resort hotel on Enchanted Mesa. McKelvey, the first member of the department to become deeply involved in city affairs since the days of DeLong and Light, joined with Albert Bartlett and Mrs. E. E. Weibel to organize a petition drive which resulted in an election in the summer of 1959 to establish the "Blue Line", with the strong backing of the *Boulder Daily Camera*. (The Blue Line was drawn along the foothills map at approximately 5750 feet in elevation, above which no city water was to be sold.) Another city election in 1962 resulted in the purchase of Enchanted Mesa. McKelvey was chairman of the "Citizens for Greenbelts" committee which persuaded the citizens of Boulder in 1967 to vote that 40% of the second cent of city sales tax would be used for greenbelt acquisition; he was for the next three years on the city's greenbelt advisory committee.

During this period a number of institutes for teachers supported by the National Science Foundation were held. Burton Jones directed one in the summer of 1957, William Briggs directed an academic year institute from 1956 to 1960 and in-service institutes, chiefly in Denver, during the years 1959-61 and 1963-64.

Various summer research institutes supported by NSF took place. There were four in the Theory of Numbers; one of 80 members in 1959, a small one probably in 1961 supported by research contracts of Professors Chowla and Jones, a larger one in 1963 under the auspices of the American Mathematical Society, and one in 1972 under the direction of Schmidt and Hodges. In 1972 there was an interna-

tional conference on Padé Approximants supported by a contract by the Air Force and directed by Thron and William Jones. Various research institutes or conferences were held in Boulder under the auspices of the American Mathematical Society which had no direct connection with the University, such as the Institute on Algebraic Groups in 1965.

The School Mathematics Study Group met in University facilities for several weeks (85 participants) in the summer of 1959 and for shorter periods at other times.

A letter from Jones to Thron in May of 1954 states that at that time two members of the department had research contracts. Though we do not know the title of either contract, we know that Chowla's was with the Air Force and Development Command for the two-year period 1953-55. Thereafter he had almost continuous contracts with the National Science Foundation until 1963 with such titles as "Dirichlet L-Series and Related Problems." Jones's contract was with the Office of Naval Research, probably for the same two-year period, and the most likely title was "Quadratic Forms." Jones probably had various contracts during the next six years, but we do know that in 1961 there was in force a contract with the National Science Foundation entitled "Studies in Quadratic Forms and Algebraic Curves." Under this contract Fischer spent the academic year 1961-62 at Harvard University working with Zariski, and Hodges and Schmidt were also partially supported. This was followed by other contracts through 1968 when Hodges and Schmidt were the co-principal investigators.

Thron's contracts with the Air Force on Continued Fractions began in 1957 and he and William Jones have also been supported by contracts with the National Science Foundation. From 1962 to 1963 McKelvey had a research contract with the National Science Foundation on Differential Boundary Value Problems. The following year Donald Monk directed a contract under the same agency on Mathematical Logic and its Algebraic Counterparts. All these contracts included much support for graduate students.

The department had a number of visitors, including: Kurt Hirsch (1954-55), Sigmund Selberg and Werner Rogosinski (1957-58), Louis Mordell (1959-60), Djuro Kurepa (Spring, 1965), Olav Stubban and Ralph Tambs Lyche (1961-62), Hans Raj Gupta (1962-63), William J. LeVeque and Haakon Waadeland (1963-64), and Indar Luthar and Sigmund Selberg for the second time (1964-65). One summer Peter Scherk was a visiting lecturer and Kurt Mahler was on the staff for two summers.

Several persons were involved in the establishment of the Kempner Colloquium. Bebernes and his colleagues in the Applied Mathematics Department were disturbed to find no regularly scheduled mathematics talks there. Though for a number of years there had been fairly regular mathematics lectures in the Mathematics Department, there was no general titled series. The idea of the name Kempner Colloquium seems to have arisen from a meeting of McKelvey, Magnus and Meyer in 1963. It was inaugurated that same year with a talk by Kempner himself.

With Magnus's impending accession to the chairmanship in 1963, he, McKelvey, and the rest of the department decided on certain procedural changes. One was a more formal committee structure including a graduate committee and an undergraduate one. It was decided that the chairmanship would be a rotating one, normally of two years' duration. This was in accord with trends in the University away from headships to a more flexible organization. Indeed this was in keeping with what was happening throughout the country. Being head or chairman was becoming less of an honor and more of a chore with increasing paperwork and size of departments. Being chairman was seen as an interruption of one's research activity and often at the end of such a stint the faculty member sought a year's leave of absence to catch up again.

McKelvey became chairman for the Fall Semester of 1965 and in December of that year, on his initiative, at the annual meeting of the American Mathematical Society a meeting was arranged among representatives of about fifteen universities to set up a consortium of institutions of the Rocky Mountain region. The objects of this organization, the Rocky Mountain Mathematical Consortium, were to provide a vehicle for regional cooperation among the Ph.D. granting institutions, organize summer conferences for the needs of researchers in the isolated centers, especially young ones, and to establish a journal to encourage the writing of expository surveys and promote research in new active areas. Their first summer conference, supported by the National Science Foundation, was held in Boulder in 1967 and the Consortium was incorporated in 1968. The journal, established in 1970, became economically self-sufficient by the time the NSF funds expired in 1973. (The present circulation of the journal is about 470.) Members of the Consortium now are most of the universities of the Rocky Mountain Region and include the Universities of Alberta, Kansas, Nebraska and three of western Texas.

In 1965 McKelvey and Jones paid visits to some of the small state colleges in the southeastern part of Colorado and as a result set up a meeting for Colorado Teachers of College Mathematics in Boulder for March 25 and 26, 1966. This non-organization has met each year since then, for the most part on the campuses of two and four year colleges with usually about 75 in attendance and now includes some institutions from Kansas and Wyoming. The chief aim of these meetings is to compare notes on new courses and trends in the teaching of mathematics.

In 1965 Jean Ferris became an instructor in the department (preceeded by nine years as a part-time instructor). She received the Outstanding Teaching Award of the Alumni Association in 1967 and became Assistant Dean of the College of Arts and Sciences in 1972.

Aubrey Kempner and Burton Jones in Kempner's house, 1952

Stanislaw Ulam
(University of Colorado Photo)

V

The Department of Mathematics, 1965-1977

During the fall of 1965 members of the Applied Mathematics Department continued to push for a Division of Mathematical Sciences and it became increasingly apparent to most of the members of the two departments that the separation into "applied" and "pure" had little to recommend it now that the outlooks and courses of the departments were becoming less and less distinguishable from each other. Accordingly with their consent and as a result of consultations with Deans Manning, Briggs and Peters, it was agreed that a department of the Mathematical Sciences was to be formed beginning July 1, 1966. Faculty personnel matters were to be referred directly to the Dean of Faculties (Dr. Manning) who "will administer the Department in consultation with the Dean of the College of Arts and Sciences and the Dean of the College of Engineering". Course offerings and membership in the two faculties were to be under the jurisdiction of the separate colleges. These arrangements were to be effective "only through the 1968-69 academic year at most". No later than 1969 was the place of the department to be reviewed and recommendations made for permanent jurisdiction. It was agreed that Arne Magnus would be the chairman of the new department beginning July 1, 1966 and pending this he was to be acting chairman of the separate departments for the spring semester of that year.

On February 25, 1966, Magnus wrote a letter to Dean Manning informing him that he could not serve either as acting chairman or chairman and would be accepting an appointment at Colorado State University as of the fall of 1966. The department then recommended that Watson Fulks "take office for a short period of time until the department can elect a permanent chairman". Later Fulks was elected chairman for a one-year term to start July 1, 1966. On January 16, 1967 due to family complications Fulks resigned as chairman and Burton Jones took over for the spring semester. During the year 1966-67 the department tried unsuccessfully to get a chairman from outside the university. Finally Stanislaw Ulam was elected chairman for a two-year term beginning July 1, 1967 and the department settled down with a sigh of relief.

Meanwhile the National Science Foundation decided to promote "new centers of excellence". A committee chaired by Dean Peters drew up a proposal and in

June of 1965 the university was awarded a grant of $3.7 million. Two-thirds of this went to provide 50 new positions in the sciences including mathematics. (Others receiving similar awards were Rice and Washington Universities, and the Universities of Arizona, Florida, Rochester, and Virginia.)

In the fall of 1965 two notable appointments were made. Robert Richtmyer came from Courant Institute to be Professor of Computing Science and Mathematics. Previous to his tenure at Courant Institute he had been head of the theoretical division at Los Alamos. Since 1968 he has held a professorship in both the Departments of Mathematics and Physics. That same year Stanislaw Ulam was also offered an appointment as Professor of Computing Science and Mathematics. For the two following years he divided his time between Boulder and Los Alamos. In 1967 he retired from the Los Alamos Scientific Laboratory and came to the university as Professor of Mathematics (and chairman of the department). Besides Richtmyer there were two on the faculty in Boulder who had been there for a number of years and with whom he had been formerly associated at Los Alamos: David Hawkins of the Philosophy Department and George Gamow of the Physics Department. Ulam is a member of the National Academy of Sciences. His honors are too numerous to mention here. His autobiographical "Adventures of a Mathematician" (Scribners, 1976) describes a fascinating life. During Ulam's original term as chairman (1967-69), Bebernes served as associate chairman. Ulam agreed to stay on for one additional year and Lundell was his associate chairman. From 1970-72 Lundell headed the department. He was succeeded by Thron (1972-74) who had W. Jones as associate chairman. The next chairman was Hermes (1974-76). Clements was associate chairman from 1975-77 and Ramsey from 1977-78. The chairman for the years 1976-78 was Bebernes. As this is written Schmidt is starting his term as chairman with Rearick as associate chairman.

When the new Engineering Center was completed early in 1966 all members of the Applied Mathematics Department moved there as did some of the members of the Mathematics Department. The remaining members moved to Ketchum and all space in Hellems was relinquished to the Philosophy Department. The rest of the members of the Mathematics Department moved over a period of years and by 1971 all full-time members of the department had their offices in the Engineering Center. At about this time a detailed proposal, including preliminary space plans by Jane Richtmyer, was made for a Mathematics Building. The building failed to materialize partly because governmental support for science had begun to wane.

The decision for the permanent status of the department was postponed until October 1971. Among the organizational structures suggested was a Division of Physical Sciences including mathematics and a splitting of the remaining College of Arts and Sciences into similar divisions. In the end the Mathematics Department became part of the College of Arts and Sciences.

1971 was also the year that the Special Assistant Professor program was started. Even though getting good candidates for these two-year terminal positions has not always been easy, having these young people in a department with little

turnover has been very helpful. A constant stream of visitors, many supported by their own institutions, has also made an important contribution to the intellectual life of the department.

Twelve new members joined the department in the fall of 1966 (seven left) to bring the total number of faculty members to 40. The department continued to grow until 1969-70 when it reached its maximum strength of 57 (however nine members were on leave that year and some of them were known not to return). The number declined from then on. It was 46 for the academic year just ended. Nevertheless the department may be even stronger now than it was in 1969. This year's Personnel Committee decided that the word "excellent" was not adequate to describe the research accomplishments of the very best researchers in the department. Thus a new category named "superior" was created. It had seven members.

Possibly more reliable indications of the growth of the department's stature are the increase in the amount of research grants from $136,800 in 1965 to $547,914 in 1978, and the solid ratings received in the Cartter report of 1964 and the Roose-Anderson report of 1969. In both of these the University of Colorado Mathematics Department ranked higher than any other department in the Rocky Mountain Region. Most significant may have been the many honors which came to members of the department: Schmidt received the Cole prize in 1972 and was one of the one-hour invited speakers at the International Congress of Mathematicians at Vancouver in 1974. Hermes has been an invited speaker both at an AMS meeting and at the last International Congress. He also serves on an NSF advisory committee and is one of the editors of the SIAM Journal on Control Theory. Schmidt is on two editorial boards. Richtmyer, Monk, Mycielski, Stroock and Taylor also serve on editorial boards of mathematical journals, and Mycielski and Stroock were invited speakers at national AMS meetings. These are only the best known among a strong group of active researchers in the department. Among the younger people, Walter and Holley have recently received Sloan fellowships and Laver has done highly praised work. That the tradition of good teaching has been maintained, in spite of strong emphasis on research, is demonstrated by the granting of the Outstanding Teacher Award of the Alumni Association to Hodges in 1968 and Goodrich in 1970. Honorary degrees were conferred on Briggs by Morningside College in 1968, on B. Jones by Grinnell College in 1973 and Ulam by the University of Wisconsin in 1978. B. Jones received the Distinguished Service Award of the MAA in 1971. Ulam was only the third mathematician (the other two were Kempner in 1939 and Chowla in 1957) to be asked to deliver the faculty research lecture in 1971. On his retirement in 1977 the department arranged a "mini-conference" and instituted the "Ulam visiting professorship" in his honor. One of the first incumbents of this chair was Paul Erdös who has been a frequent visitor to Boulder on other occasions also.

Finally, we might mention that our 154 Ph.D.s have held or are now occupying positions throughout the country: from the Universities of Massachusetts and Maryland in the East to the University of California and various California State Universties in the West. A large number of them found positions in Colorado and Wyoming.

VI

Graduate Work in Mathematics

Though the Graduate School of the University was not officially organized until 1909 and though in the early years a large portion of the students at the University belonged to the Preparatory Department, there was nevertheless some activity at the graduate level. The first advanced degrees were:

1886—Doctor of Medicine—Gustave Beauregard Blake
Hollis Illsey Bragdon
1887—Master of Arts—Silas Edward Persons
Richard Henry Whiteley, Jr.
1899—Doctor of Philosophy—Calvin Smith Brown
Arthur John Fynn

The first M.A. in mathematics was granted to Frank Albee Giffin in 1900. He eventually became a consulting engineer with the General Electric Corporation.

It is hard to visualize what graduate work meant in those early days. In particular it appears that course work, though offered to some extent, did not constitute an essential requirement for an advanced degree. This was true not only at the University of Colorado. Emch, who almost certainly was responsible for much of the early graduate supervision at Boulder, received his M.S. within one year at Kansas Agricultural College and his Ph.D. also within one year at the University of Kansas. Similarly, Epsteen, who succeeded Emch, obtained his Ph.D. degree at Zürich a year after he had graduated from the University of California.

Almost certainly a thesis was required for a master's degree. Copies of most theses can be found in the University library. At least two of the master's theses in mathematics were published: Alwyn Smith's in the *American Mathematical Monthly* and Ruby Carstens' in the *University of Colorado Studies*. Unfortunately the names of theses directors were not given until 1928 so that before then it is frequently difficult to know who guided which student. Probably Neikirk, A. Smith, H. Emch, Akers, and Elden were Emch's students. Carstens, Eaton, G. Smith, and Kendall appear to be students of Epsteen. Shufelt, Belser, and Snell may have been working under DeLong.

The quality of this first group of recipients of master's degrees was surpisingly high. Neikirk, Akers, Eaton, G. Smith, and Kendall went on to earn Ph.D. degrees at the University of Pennsylvania, Cornell University, University of Indiana (Physics), University of Illinois, and University of Chicago, respectively. They went on (or returned) to teaching positions at the University of Washington, Allegheny College, Northern Illinois University, University of Kansas, and University of Colorado.

Alwyn Smith taught at Colorado School of Mines for a few years and Ruby Carstens taught in Boulder from 1905 until 1909.

While DeLong appreciated the importance of research his strength lay in teaching and administration. Emch and Epsteen, however, were both active research mathematicians. Emch had published 40 papers by the time he left Boulder in 1905 and Epsteen had written 18 articles before he gave up mathematics for insurance and banking.

It was also during this first period of significant mathematical activity in Boulder that the first Ph.D. degree in mathematics was awarded at the University. The recipient was Heman Burr Leonard. He had worked with Epsteen in Chicago and came with him to Boulder to finish his work. The title of his dissertation was "On the factoring of composite hypercomplex number systems." It was published in the *American Journal of Mathematics* (vol. 30, 1908, pp. 43-64). Leonard had received his B.A. from the University of Michigan in 1895 and was in Chicago during 1903-05. After receiving his Ph.D., Leonard went on to the University of Oregon from 1906-15. In 1915 he became professor and head of the Department of Mathematics at the University of Arizona. He died in 1955.

Besides the 14 people who received advanced degrees between 1900 and 1914, there were a number of others who were listed as graduate students in mathematics but then shifted either to other areas (which was very common in those days) or left Boulder to pursue their graduate work somewhere else. Among the latter was W. E. Eddington who was a graduate student here in 1913-14, after spending 1912-13 in Chicago. He then went on to the University of Illinois to receive his Ph.D. and taught at New Mexico, Purdue and DePauw (1930-53). He died in 1977.

It may be of interest to note that at the University of Kansas, which was founded in 1866, only nine masters and one doctors degree in mathematics were granted thorugh 1910.

From 1913-15 none of the members of the two mathematics departments in Boulder had a Ph.D. In 1915 N. Altshiller-Court joined the Department of Mathematics but stayed only for a year. He went on to a distinguished career as a geometer at the University of Oklahoma. In 1916 George Light came to the University with a fresh Ph.D. from Yale and stayed until his retirement in 1943. When Claribell Kendall received her Ph.D. degree from the University of Chicago in 1921, there were for the first time two people with doctor's degrees in the Mathematics Department. Possibly because of this the hiatus in the production of advanced degrees came to an end in 1921. The fact that the enrollment in the

Graduate School rose from 53 in 1919-20 to 141 in 1922-23 may also have helped.

Neither Light nor Kendall were active researchers. Light published a short paper in the *Bulletin* of the A.M.S. in 1918 and two papers in the *Monthly* (1920,28). Kendall's only publication was her dissertation (*Amer. J. Math* vol. 45, 1923, pp. 25-41). Both, however, directed a fair number of master's theses.

Light had at least seven and possibly as many as ten students. They received their degrees between 1922-35. Among his students were Andrew Clark who filled important posts at Colorado State University. He was successively an instructor (1923-25), assistant professor (1925-33), associate professor (1933-40), and professor (1940-1965). He also was head of the department (1941-52) and dean of the faculty (1952-1965). Sidney Hacker earned a Ph.D. (astronomy) at Princeton in 1934 and then returned to mathematics at Washington State University. Guy March had a long career at South Dakota School of Mines (1922-65, head 1940-60). Clarence Lindahl went on to Iowa State, where he also received his Ph.D. in 1952.

Claribell Kendall had probably 10 masters students. Jane Moore who completed her degree in 1924 is the one we are not certain about. Her last student was in 1955. Her best known student was Edwin Purcell. He earned his Ph.D. at Cornell University in 1932 and taught at the University of Arizona from 1935 until his retirement in 1966. He wrote a successful calculus text the second edition of which he dedicated to Aubrey Kempner.

We do not know under whom Ruth Alden, Borden Hoover, Emory Walden, and Raymond Staley received their masters degrees. Alden became an expert in educational testing, Hoover received a Ph.D. from Illinois in 1925 and then taught at Carnegie Institute of Technology. Walden also took a Ph.D. at the University of Illinois (1934) and has been at New Mexico State University since 1942. He was Dean of the Graduate School from 1956-66 and retired in 1966. Staley received a Ph.D. from the University of Michigan in 1938 and has been at the University of North Dakota since 1927.

In 1925 DeLong retired and Aubrey Kempner succeeded him as head of the Mathematics Department. Kempner had done distinguished work in number theory and algebra (in particular in the theory of polynomial equations) before coming to Boulder. After he came here his substantial energies were devoted more to administrative work, both for the department and for national mathematical orgnaizations, to expository writing and to the direction of theses. His total published work comprising research papers, shorter notes and expository articles, consisted of 23 publications. Twenty-one students wrote their master's theses under his direction between 1928 and 1944. In addition he had four Ph.D. students.

Laura Louise Johnson Rosenbaum was a student (she was then a sophomore) in his first calculus class in Boulder. In 1933 she received an M.A. from him and in 1939 a Ph.D. Her dissertation was entitled "On the diophantine equations $x(x+1) \ldots (x+n-1) = y^k$" and was published in the *Monthly* (vol. 47, 1940, pp. 280-89). She also served as assistant or instructor in the department in 1930-32 and 1934-38.

After receiving her Ph.D. she taught at Reed College where she met her husband.

Of Kempner's master's students David Richert received an honorary D.Sc. from Bethel College where he taught from 1915-46. Everett Westerfield went on to a Ph.D. in Physics at the University in 1940 and was working for various research laboratories before his retirement in 1975. Leslie Madison returned to Colorado State University and has been on its faculty since 1935. Ruth Hoffman became an expert on mathematical education and is now a professor at the University of Denver.

Kempner's other Ph.D. students were: Arthur J. Lewis with a thesis on "Solution of algebraic equations in one unknown quantity by infinite series" in 1932. Lewis returned to his alma mater, the University of Denver, as head of the department. He died in 1961. In 1936 Jack R. Britton received his Ph.D. degree. He wrote on 'Tchebycheff orthogonal polynomials in a single real variable." He thus became the first member of the Engineering Mathematics Department, since Epsteen left in 1913, with a Ph.D. Marjorie Louise Heckel Beaty received her Ph.D. in 1939. Her dissertation was on "Complex roots of algebraic equations." She returned to the University of South Dakota where she had taught since 1931. She became a full professor in 1961.

Charles Hutchinson, who joined the Engineering Mathematics Department in 1918 when he was only 21 year sold, never earned a Ph.D. himself but began to play an active role in the teaching of graduate courses and directing of master's theses in the later twenties. Berry, F. Kendall, and Ehrenburg may have been his students judging from the titles of their theses. His known students up to 1945 were Middlemiss, Folk, Anderson, Rainville, and Specht. For Elliott, Olpin, and Kellum he appears to have been co-director with Kendall and Kempner, respectively.

Ross Middlemiss went to Washington University (St. Louis) in 1929 and retired from there in 1969. He became known as the author of textbooks on algebra, analytic geometry, and calculus and was a distinguished teacher. He now lives in Canon City. Earl Rainville received a Ph.D. from the University of Michigan in 1939 and taught there from 1937 until his death in 1966. He was known both for his books and his research on differential equations. Edward Specht earned a Ph.D. at the University of Minnesota in 1949 and is now teaching in Indiana University at South Bend.

It appears that Boulder, in those days, was blessed wih three outstanding teachers in Hutchinson, Kempner, and Kendall and that this had a bearing on their students' interests which tended much more towards teaching than towards research. That there was also a great deal of administrative talent among these students is probably harder to explain.

During the Kempner years (1925-49) there were 48 successful master's degree recipients and 4 persons who obtained a Ph.D. Since the enrollment in the Graduate School was only 390 during the academic year but 1500 in summer school (the figures are for 1938-39) it is not surprising that a fair number of the master's

degrees were earned during the summer. We may assume that many who came to summer school had to leave without a degree. We know that the attrition rate was surprisingly high during the academic year. Of the 17 persons who are known to have held scholarships and/or fellowships in mathematics between 1931 and 1944 only seven received degrees.

The awarding of master's degrees based only on summer school work continued after the war but came to an end in the late fifties.

With the end of the war, the retirement of Kempner and his replacement by Burton Jones, the pace of graduate work changed at first slowly then much faster. While the output of master's degrees continued to increase particularly after the "plan II" (without a thesis) came into vogue and hit a maximum of 46 (both M.A. and M.S.) in a single year in 1968 the shift in emphasis was definitely towards turning out Ph.D. degrees.

Ph.D. Output	-1949	50-54	55-59	60-64	65-69	70-71
all U.S.	1904	1037	1197	2083	4318	2458
University of Kansas	7	7	12	12	36	7
University of Colorado	5	5	5	24	45	22
Colorado/U.S. %	.26	.5	.41	1.15	1.05	.88

The reasons for this development were to some extent external: availability of jobs, improving salaries, substantial federal support by means of fellowships and research grants, and the prestige enjoyed by scientists (including mathematicians).

Among the internal factors possibly the single most important one was the willingness of Burton Jones to surround himself with colleagues of comparable mathematical stature, amd his ability to convince the administration to make such appointments. Thus Edrei came in 1951, though only for a year. In 1952 Jones was able to get S. Chowla to come to Boulder. His presence here gave a great impetus to the graduate program and by his example as a prolific, enthusiastic, and extremely gifted researcher he helped in making both the students and the faculty more research-oriented. Later Thron, Magnus, McKelvey, Fischer, Hodges, Schmidt, and Monk (who all came to Colorado under Jones' chairmanship) helped to establish a solid and broadly based graduate program. While Thron with 19, Chowla with 13, B. Jones and Monk with 8 each, have produced the largest number of doctoral students, 32 of the present faculty have directed at least one Ph.D. dissertation and 15 have directed three or more.

Another internal factor was that the number of teaching assistantships (sometimes called part-time instructorships) was increased and made more generally

available to students working on advanced degrees in mathematics. This replacement took quite a number of years. Even in 1955 about half of the available positions were filled by persons who were interested mainly in teaching lower division mathematics courses.

When the faculty was still small it was particularly helpful to have distinguished visitors to help with the graduate program. Kurt Hirsch spent the year 1954-55 in Boulder. Sigmund Selberg and Werner Rogosinski were here in 1957-58. After that came Louis Mordell (1959-60), Olav Stubban and Ralph Tambs Lyche (1961-62), Hans Raj Gupta (1962-63), William LeVeque and Haakon Waadeland (1963-64), Indar Luthar (1964-65), and Djuro Kurepa (spring 1965).

The last internal factor was a change in orientation and in emphasis in the Engineering Mathematics Department. When it changed its name to "Applied Mathematics Department" in 1948 it was given the right to give M.S. degrees. Between 1913, when Epsteen left the University, and 1948 none of the members of the Engineering Mathematics Department other than Hutchinson participated in the graduate program. It is true that most of the 26 members of the department were only instructors, but Britton and Nelson were associate professors and Snively, Stahl, and Tovani were assistant professors. The situation now changed. Britton gave his first master's degree in 1951 and then granted in fast succession four Ph.D. degrees, two in 1954 and two in 1956.

While instructors in the department had been permitted (or even encouraged?) to acquire master's degrees in various fields of engineering, physics and mathematics, the only one of the group who received a Ph.D. was Britton in 1936. In 1954 Rutland earned a Ph.D. in mathematics under Britton and in 1962 Aull and DePree, both full-time instructors in the Applied Mathematics Department, received Ph.D. degrees.

Britton continued to move the department into more involvement with graduate work when he became chairman in 1962. With the very active encouragement of the new dean and higher administration he began to bring research-oriented persons into the Applied Mathematics Department. These new people with Fulks, Meisters, and Wing as leaders soon came to the conclusion that for the most efficient running of the graduate program it would be highly desirable to combine the two departments. Details were worked out during 1965 and by July 1, 1966 the merger was officially completed and there was but one Mathematics Department at the University.

Stanislaw Ulam headed the new department from 1967-70 and lent it the prestige of his name. Robert Richtmyer had already joined the University in 1965 and did his share in making the University better known in national and international mathematical circles. This helped in attracting other people of promise and some with already established reputations to the department after 1966. They in turn made it possible to take care of the vastly larger number of graduate students that came to the department in the late sixties and early seventies.

As this is written things have changed greatly, the mathematical community

has become discouraged and pessimistic largely because of the deterioration in the factors mentioned earlier—availability of jobs, decreasing salaries, less support from the federal and state governments, loss of prestige.

The graduate program is down to about 80 full-time graduate students (from a maximum of about twice that number in 1967) making it difficult to offer a full program. Also pure mathematics is (not for the first time) under attack as being too impractical and there is a strong demand for introducing much more applied mathematics into the graduate program.

What the outcome will be is hard to predict at this time. Possibly it would be helpful to place renewed emphasis on the master's degree with thesis. This way more faculty can be kept involved in the graduate program and the person-to-person contact between faculty members and graduate students can be increased. In addition a rethinking of the whole graduate program appears to be called for.

VII

The Mathematics Library Until 1940

In the University's catalogue for 1878-79, it is stated that the library contained over 1500 volumes. This and some later statements about library holdings were almost certainly the results of wishful thinking. However, when the books were catalogued systematically and given accession numbers in 1885, there were indeed 2350 volumes in the library. The library was helped materially by gifts of $2000 from Buckingham in 1883 and $200 in 1888 (there were probably earlier gifts, too, because going back at least to 1878 the University library was known as the Buckingham Library). Gifts from the Colorado Scientific Society also helped, in particular with proceedings of various learned societies. The Regents, on their part, recognized the importance of a library by making special appropriations of $2500 in 1885, $1000 in 1888, and $2000 in 1889. In 1890, when the library had grown to over 5000 volumes, we find the following comment in the catalogue:

> "The library, though small, possesses rare and costly volumes to consult which scholars are already attracted to the University. . . A choice mathematical library embracing Montuclas *Histoire des Mathematiques*, Hoffman's *Wörterbuch*, the works of Gauss, Jacobi, and Cremona. . ."

In addition to the books mentioned above, the library acquired collected works of Abel and Carnot in 1888, Laplace in 1896, Cayley and H. J. S. Smith in 1897, Steiner in 1903 and Lagrange, Riemann and Sylvester in 1904. Klein's lectures at the International Congress in Chicago in 1893 were in the library in 1894 and the Proceedings of the International Congress in 1900 had been received by 1903. The *Encyklopaedie der Mathematischen Wissenschaften* was subscribed to beginning in 1904.

The following list of journal subscriptions in mathematics gives an indication of the steady improvement in the quality of the library:

Journal Subscriptions

Title	*Current Since*	*Additional Volumes Purchased*
American Journal of Mathematics	1884	
Annals of Mathematics	1892	1891 (1884-88)
Quarterly Journal of Mathematics	1893	1930
Proceedings of the London Mathematical Society	1894	1895
Comptes Rendus (Paris)	1894	1888, 92, . . .
Cambridge Mathematical Journal		1897 (vols. 1-13)
Zeitschrift für Mathematik und Physik	1901	
Mathematics from the Educational Times	1901	
Bulletin of the American Mathematical Society	1902	1909, 16
Archiv für Mathematik und Physik	1902	
Transactions of the American Mathematical Society	1903	1906 (1900-02)
American Mathematical Monthly	1903	
Intermediaire	1903	
Mathematical Gazette	1904	
L'Enseignement Mathématique	1905	
Messenger of Mathematics	1908	1897 (1962-96)
Mathematische Annalen	1910	1910, 12, 17, 24
Journal für die reine und augewandte Mathematik	1918	1884, 85, 87, 88, 89 1922, 29, 37
Journal of Mathematics and Physics	1921	
Journal de Mathématiques pures et appliquées	1923	1913, 18, 20, 22
Acta Mathematica	1926	1928 (1882-1923)
Bulletin de Societé Mathematique de France	1928	1928 (1872-1903)
Bulletin des Sciences Mathématiques	1928	1929 (1870-1927)
Rendicontin di circolo matematico di Palermo	1929	1905-11, 27, 28, 29
Fundamenta Mathematicae	1930	1930
Tôhoku Mathematical Journal	1930	1930
Mathematische und naturwissenschaftliche Berichte aus Ungarn		1930 (vols. 1-31)
Nyt Tidskrift		1931 (vols. 1-29)
Nouvelles Annales de Mathématique		1931 (1842-1924)
Jahresbericht der Deutschen Mathematiker Vereinigung	1931	1909, 29, 30
Compositio Mathematica	1934	
Duke Mathematical Journal	1935	
Mathematische Zeitschrift	1936	after 1950
Scripta Mathematicae	1937	

Review Journals

Annali di Matematica pura ed applicata	1938	1939 (1924-37)
Jahrbuch über die Fortschritte der Mathematik	1926	
Revue Semestrielle	1925-34	1905, 28, 29, 30
Zentralblatt der Mathematik und ihrer Grenzgebiete	1934	1936
Mathematical Reviews	1940	

This progress was made against a background of a succession of financial crises of the University. Thus in 1884 besides the *American Journal*, publications that were subscribed to included *Crelle's Journal*, the *Mathematical Magazine* and the *Mathematical Visitor*, but most had to be given up. In the early 1900's *Rendiconti di Palermo*, *Jahresbericht der DMV* and *Revue Semestrielle* were received but all three were soon discontinued.

It is an interesting speculation as to which faculty member may have been responsible for which acquisition. We leave this to the reader. The list however clearly speaks for the scholarly interest and good mathematical taste of Hanus and DeLong (even if not pushed by Emch and Epsteen, who almost certainly had some influence on the books and journals bought between 1900 and 1913). Between 1913 and 1925 only three new journals were added as well as a few back files. The situation changed drastically with the arrival of Kempner in 1925. Helped by special appropriations of $500 in 1926, $1500 in 1929 and $500 in 1930 as well as ordinary appropriations for "books and supplies" ranging from a minimum of $250 in 1934 to a maximum of $550 in 1929-30-31, Kempner did wonders in getting new subscriptions as well as in acquiring back issues. The only really surprising thing about the journals he ordered is that he did not get *Mathematische Zeitschrift* until 1936 (which was by then surely one of the best ten mathematical journals, catering to all parts of pure mathematics) and that he subscribed to *Fundamenta Mathematicae* already in 1930, even though this journal is devoted to abstract disciplines (set theory, topology, . . .) for which Kempner had no liking. That *Tôhoku Journal* was received from 1930 on is not surprising since this was one of the journals in which Kempner published.

A reflection of his sound sense of scholarship is that soon after his arrival *Revue Semestrielle* was reordered, the *Jahrbuch über die Fortschritte der Mathematik* was ordered in 1926 and *Zentralblatt* was subscribed to from 1934 on. *Mathematical Reviews* was received as soon as it began publication in 1940.

After the war the holdings of the department, particularly in periodicals, were vastly extended, but the credit for this belongs to a large group of faculty members, so that it would be unfair to single out individuals.

VIII

Salaries

When we found almost complete information on salaries paid up to 1921-22, we thought we might say something about this topic. For the remaining years our data are much more fragmentary, but adequate—we hope—to give a picture of what happened.

With the present rampant inflation we have almost forgotten that salaries used to increase very slowly and, for people at the full professor level, frequently not at all for many years in a row.

Decreases in salary, however, (once one was hired) were rare. The only case we know about (other than a cut in salary for everybody in 1933) in mathematics is that of Hanus who started with a salary of $1200 in 1879 and then received successively $1200, (not at CU), $1900, $2200, $2000, $1800. For beginning salaries there was a surprising amount of oscillation only in part determined by previous experience and almost not at all by advanced degrees. Here are the figures we have for people in mathematics: *1878:* $1100, *1879:* $1200, see above for Hanus, *1883: $400, 1886:* $1600, *1888:* $1600, *1889:* $1400, *1890:* $600, *1900:* $500, *1905:* $800, *1908:* $800, $800, *1909:* $500, *1910:* $500, *1911:* $800, *1913:* $800, $1400, $800, $800, *1914:* $800, *1915:* $800, $500, $1200, *1916:* $1200, *1918:* $1200, $1100, $1125, *1919:* $1200, *1920:* $750, $1200, $1300, *1921:* $1300, $1300, $1700. By 1921 a pattern seems to have been established. By 1938 beginning salaries had only advanced to $1500 and by 1946 to $2000.

An interesting phenomenon in the early years was a very low salary in the first year followed by substantial raises and quick promotion. Thus Emch who had a Ph.D. when he came in 1900 started with $500 but was raised to $1200 the next year. When Epsteen came in 1905 with a Ph.D. from Zürich, one additional year at Göttingen and three at Chicago, his salary was only $800 per annum for his first two years in Boulder. Elva Cooper in 1910 was paid only $500; the next year she was raised to $800. Light in 1916 with a fresh Ph.D. from Yale and substantial teaching experience started as an assistant professor at $1200. By 1920 he was a full professor at a salary of $2500. Similarly, Hutchinson who came with no experience and an M.A. in 1918 at $1200 was an assistant professor and received $2200 in 1921.

That little weight was assigned to research in those days is illustrated by the fact that Emch in his fifth year got only $1500 and Epsteen in his eighth year only received $1600. DeLong was one of the most highly paid professors in the university. He received $2000 annually from 1892-1901, $2500 from 1904-1911, $3000 from 1915-1917 and $3800 in 1921.

Salaries in Boulder were comparable to those paid by other state universities in those days. Around 1920 an instructor at the University of Kansas received about $1000, an assistant professor $1500, an associate professor $2000, and a professor $2500. At the University of Illinois the figures were: instructor $1300, assistant professor $2350, associate professor $3000, professor $3700.

Salaries in the mathematics department rose slowly and reached a peak in 1932-33. In that year the salaries in the department were $4300, $3600, $2800, $2400 and $2100. In the next year, due to the depression a salary cut ranging from 11.4% in the higher ranges to 8.2% in the lower ranges was instituted.

It was not until 1936 that the cuts were fully restored and Kempner had to wait until 1946 before his salary exceeded that for 1932-33. Light, Hazard and Kendall were ahead by 1940 and Stribic by 1936. The cut in salary during the depression was widespread though the formula used differed from institution to institution.

The phenomenon that people with Ph.D. degrees received very little more as initial salary than those with only a B.A. was nation wide. The gap began to widen after the war. Thus, Farnell came in 1946 at a salary of $3184 (adjusted to 9 months) as an assistant professor with a Ph.D. For a number of years at least the professorial ranks were paid on a "12 month basis" with the understanding that they would teach some summer school courses. This was discontinued for the year 1956-57. In order to avoid confusion we quote all salaries on a 9 month basis.

Beginning salaries for fresh Ph.D.'s rose at first slowly. After that, for a while they improved rapidly. They probably had reached $3500 in 1955, $6000 in 1960 and $8000 in 1964. For next year (1978-79) the department is paying $13,750, the rate of growth having slowed markedly in recent years.

Top salaries also rose fairly spectacularly. In his last year (1948-49) Kempner received $6188. In 1955 after a great deal of argument the ceiling of $7514 was raised. B. Jones and Hutchinson were among the beneficiaries. By 1960 the highest professorial salary paid in the University at Boulder was $13,500. The next year the ceiling was raised to $18,000—there being only four people in the $17,400-$18,000 range. Chowla was one of two professors receiving $16,000. For 1962-63 both Chowla and Jones were among the top 14 with salaries of $16,000 or above in Boulder.

By 1966-67 there were 13 professors getting $20,000 or more; four of these were in the Mathematics Department. In 1970-71, 19 salaries were in the $25,000-$31,000 range. Again, four of these were mathematicians. In 1976-77 there were four mathematicians among the 12 in the College of Arts and Sciences with salaries over $33,000. For the coming academic year (1978-79) seven members of the

department will receive salaries of more than $30,000. While these figures show that the Mathematics Department gets at least its share of high salaries in the university, it does not show the unfortunate fact that inflation is outrunning the dollar gains made by most members of the department.

IX

Women in the Department

Here are some fairly rough national figures to give perspective to what we have to say about the University of Colorado. From 1920-45 the percentage of women among those receiving a Ph.D. degree in mathematics was 14%, from 1946-71 it was 6%. It may have increased a little in the last few years. For the years 1948-60 the percentage of women receiving a bachelor's degree in mathematics was 29%, for the master's degree it was 19% and for Ph.D.'s it was 6%. The greater attrition among women is very marked. Of 100 men receiving a bachelor's degree 19 received a master's degree and 5 a Ph.D. Of 100 women completing a bachelor's degree only 11 went on to a master's degree and only .7 to a Ph.D. Finally, a reasonable guess for the percentage of women among all master's degree recipients is probably 30%.

The figures for Boulder favor women in the Mathematics Department before the war and appear to be considerably worse than average after the war. For the Engineering Mathematics Department the record is relatively poor. The relatively low percentage of women among all master's degree recipients is probably in part due to the fact that among M.S. recipients (inaugurated by the Applied Mathematics Department in 1948) the percentage of women was only 10.5.

Particularly noteworthy is the percentage of women in the Mathematics Department up to 1957. Here we have the following figures:

1908-09:	50%	1946-48:	60%
1910-15:	50%	1948-52:	50%
1915-20:	33%	1952-53:	40%
1921-24:	33%	1953-55:	33%
1925-26:	25%	1955-56:	28%
1926-42:	40%	1956-57:	25%
1942-43:	60%	1957-58:	10%
1943-46:	75%		

The first woman on the mathematics faculty was Ruby Carstens. She received her B.A. in 1905 and her M.A. in 1906 at Boulder and was an assistant from 1905-08 and an instructor from 1908-09. She was followed by Elva Cooper who had obtained

a B.A. in 1904 and an M.A. in 1906 from the University of Wisconsin and was an instructor here from 1910-13. (She was also enrolled as a graduate student during these years.) Claribell Kendall started teaching as an assistant even before she received her B.A. and B.E. in 1912. She became a full-time instructor in 1913 and continued to teach at the university, except for one year when she was in Chicago to complete work on her Ph.D., until her retirement in 1957. She became a full professor in 1944 and so far has been the only woman to attain that rank. Frances Stribic taught in the department from 1926-65. She retired as an associate professor. Georgia Louise Scott Arnett joined the department in 1942 as an instructor and stayed until 1948. (She taught part-time thereafter for a few years.) She had received B.A. and M.A. degrees from Colorado College.

There were some women also in the Engineering Mathematics Department (and its successor the Applied Mathematics Department). They were Elsie Eaves 1919-21 (three terms) and Agnes Wright 1920-21 (one term). After that there was no woman teaching in that department until Lillie C. Walters became an instructor in 1945. She stayed until 1952. Amy Coats 1946-49, Peggy Wiegand 1947-48, Carolyn Martinson and Kathleen Anderson 1955-56, Anna Merrill 1956-57 and Mildred Smith 1957-61 were also instructors in the Applied Mathematics Department. Note that for the year 1947-48 there were three women (out of 26) on the Engineering Mathematics faculty.

In addition there were women who were assistants in the Mathematics Department: L. Louise Johnson 1930-32, 34-38, Marjorie Heckel Beaty 1935-37, Margaret Rempfer 1939-40, Jean Bronfenbrenner 1943-44, Elvie Frederickson 1943-44, Marion Fenton Leveque 1943-44, and possibly others.

As far as master's degree recipients were concerned there were no women among the first five (1900-02). However in the next group (1903-14) six out of the eight were women. From 1921-27 the ratio was 6 out of 15 and from 1928-45 there were 12 women among 37. Of Kempner's 21 master's students 7 were women as were two of his 4 Ph.D. students. Kendall had six women among her 10 successful master's students. Stribic had but one student and she was a woman. Light and Hutchinson had one woman student each. In addition there were a few women students whose thesis directors are not known.

It seems clear that Kempner welcomed women both as colleagues and as students. Earlier DeLong as well as Epsteen appear to have had no prejudices against women in the university. That women did not have much of a chance in an *engineering* mathematics department is, unfortunately, not surprising.

After the retirement of Kendall in 1957 the department grew and positions became available. Why so few were filled with women is hard to say. Marguerite E. Dunton was an acting assistant professor for a year (1960-61) after she finished her Ph.D. in 1960. In 1961 Ruth Rebekka Struik came to Boulder for two years and returned in 1970 as an associate professor. Both of these applied for available positions and were appointed to them. We have no recollection of women applying for jobs and being turned down because they were women. We do however remember two occasions in the late fifties or early sixties when the Mathematics Department tried to hire extremely well qualified couples. Both times the department was turned down by the upper administration on the basis of nepotism, though the official nepotism rules of the university did not exclude the hiring of couples. The next woman (and the only one on the faculty from 1965-70) to join the department was Jean Ferris in 1965. She taught in the department until 1972 and is now Assistant Dean in the College of Arts and Sciences.

In the early seventies pressure was put on the department to hire women if qualified ones could be found. Mani Gagrat was a visiting assistant professor 1972-74, Linda Hill a special assistant professor 1973-75 and Nancy Warren an assistant professor in 1973-75. When she resigned Edith Stevenson joined the department as an assistant professor (1975). A number of other offers were made to women but were not accepted. Also, of course, few positions have been available in the last years.

As far as women students are concerned our postwar record also has been disappointing. Below are the percentages of women receiving master's degrees (both M.A. and M.S.) at the university in mathematics:

1900-20	50%	1960-64	14.7%
1921-27	40%	1965-69	14.8%
1928-45	32.4%	1970-74	18%
1946-54	19%	1975-78	13.2%
1954-59	13.3%		

The annual fluctuations have been quite wide. Thus in 1967-68 there were 11 women among the 46 who received master's degrees (24%) while in 1974-75 there were no women among 21 recipients.

Below we list all women who have received Ph.D.s in mathematics up to now:

1939	Marjorie Heckel Beaty
	Laura Louise Johnson (Rosenbaum)
1960	Marguerite E. Dunton
1961	Paromita Chowla
1966	Ellen E. Reed
1967	Harsh Anand Passi
1970	Susan E. Zimmerman (Andima)
1974	Eloise H. Carlton
1977	Carol A. Bateson

The percentages are:

1877-1949	40%
1950-59	0%

1960-69	5.8%
1970-78	4.2%

Employment opportunities for women in mathematics have clearly improved but so have those in medicine, law and engineering. The result has been that for the past year among our approximately 80 full time graduate students there were only 5 women. However preliminary reports indicate a substantial change for the better next year.

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Department of Mathematics Faculty

1878-79	Instructor—Frank W. Gove
1879-81	Instructor—Paul H. Hanus
1882-83	Professor—Paul H. Hanus
1883-85	Professors—Hanus, W. F. C. Hasson
1885-86	Professor—Hanus
1886-88	Professor—William Campbell
1888-89	Professor—Ira Mitchell DeLong
1889-90	Professor—DeLong
	Lecturer—Maurice Dunham
1890-92	Professor—DeLong
	Instructor—Herbert E. Cobb
1892-00	Professor—DeLong
1900-05	Professor—DeLong
	Assistant—Arnold Emch
1905-06	Professor—DeLong
	Instructor—Saul Epsteen
1906-08	*Mathematics*
	Professor DeLong
	Engineering Mathematics
	Assistant Professor—Epsteen
1908-09	*Mathematics*
	Professor DeLong
	Instructor—Ruby Lily Carstens
	Engineering Mathematics
	Assistant Professor—Epsteen
	Instructor—James S. Mikesh
1909-10	*Mathematics*
	Professor—DeLong
	Instructor—Hampartsoon H. Der Harootunian

Engineering Mathematics
*Assistant—Epsteen
Instructor—Guy W. Smith

1910-11 *Mathematics*
Professor—DeLong
Instructor—Elva Cooper

Engineering Mathematics
Professor—Epsteen
Instructor—Smith

1911-13 *Mathematics*
Professor—DeLong
Instructor—Cooper

Engineering Mathematics
Professor—Epsteen
Instructors—Smith, Carl M. Duff

1913-14 *Mathematics*
Professor—DeLong
Instructor—Claribel Kendall

Engineering Mathematics
Assistant—Joseph B. Morrill
Instructors—Charles Sperry, William J. Christian

1914-15 *Mathematics*
Professor—DeLong
Instructor—Kendall

Engineering Mathematics
Assistant—Morrill
Instructors—Sperry, Christian, James J. Doland

1915-16 *Mathematics*
Professor—DeLong
Instructor—Nathan Altshiller-Court, Kendall

Engineering Mathematics
Assistant—Sperry
Instructors—Doland, John J. Flack, Clair V. Mann

*Henceforth Assistant refers to Assistant Professor.

1916-18 *Mathematics*
Professor—DeLong
Assistant—George H. Light
Instructor—Kendall

Engineering Mathematics
Assistant—Sperry
Instructors—Flack, Mann, Elbert L. McGrath

1918-19 *Mathematics*
Professor—DeLong
*Associate—Light
Instructor—Kendall

Engineering Mathematics
Assistant—Sperry
Instructors—Charles A. Hutchinson, O. Randolph Dungan, Herman Strauss

1919-20 *Mathematics*
Professor—DeLong
Associate—Light
Instructor—Kendall

Engineering Mathematics
Assistant—Sperry
Instructors—Hutchinson, McGrath, Froese, Murray F. Skinker, Paul Huntzicker, Elsie Eaves, Walter K. Nelson

1920-21 *Mathematics*
Professor—DeLong, Light
Instructor—William H. Hill, Kendall

Engineering Mathematics
Professor—Sperry
Assistant—Hutchinson
Instructors—Skinker, Nelson, Frank Stubbs, Henry A. Page, Eaves, Agnes Wright

1921-22 *Mathematics*
Professor—DeLong, Light
Instructor—Kendall

*Henceforth Associate refers to Associate Professor.

Engineering Mathematics
Professor—Sperry
Assistant—Hutchinson
Instructors—Nelson, Stubbs, Charles Koepke, Oscar Robertson, Holga Thuesen

1922-23 *Mathematics*
Professor—DeLong, Light
Assistant—Kendall

Engineering Mathematics
Professor—Sperry
Associate—Hutchinson
Assistant—Nelson
Instructor—Stubbs, Marion Dice, Robertson, VanDyke, Clarence Kiefer

1923-24 *Mathematics*
Professor—DeLong, Light
Assistant—Kendall

Engineering Mathematics
Professor—Sperry
Associate—Hutchinson
Assistant—Nelson
Instructor—VanDyke, Perry Ford, Frank Carswell, Louis Schnell, Paul Swingle

1924-25 *Mathematics*
Professor—DeLong, Light
Assistant—Kendall
Instructor—William Hazard

Engineering Mathematics
Professor—Hutchinson
Assistant—Nelson
Instructor—William Berry, Ivan Hebel, Alan McMaster, Elmer Peterson, Harlan Palmer

1925-26 *Mathematics*
Professor—Aubrey Kempner, Light
Assistant—Kendall
Instructor—Hazard

Engineering Mathematics
Professor—Hutchinson
Assistant—Nelson
Instructor—Berry, Hebel, McMaster, Peterson, Ernest Tovani

1926-27 *Mathematics*
Professor—Kempner, Light
Assistant—Kendall
Instructor—Hazard, Frances Stribic

Engineering Mathematics
Professor—Hutchinson
Assistant—Nelson
Instructor—McMaster, Tovani, E. Milton Boone, Ross Middlemiss, Peterson

1927-28 *Mathematics*
Professor—Kempner, Light
Assistant—Kendall
Instructor—Hazard, Stribic

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Instructor—McMaster, Tovani, Boone, Middlemiss, Peterson

1928-29 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Instructor—Hazard, Stribic

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Instructor—McMaster, Tovani, Middlemiss, Peterson, Herman Karnow, Orval Polk

1929-30 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Instructor—Hazard, Stribic

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Instructor—McMaster, Tovani, L. Clifton Snively, Jack Britton

1930-33 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Instructor—Hazard, Stribic

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani
Instructor—Snively, Britton, Earl D. Rainville

1933-37 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Instructor—Hazard, Stribic

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani
Instructor—Snively, Britton

1937-38 *Mathematics*
Professors—Kempner, Light
Associate—Kendall
Assistant—Stribic
Instructor—Hazard

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani, Britton
Instructor—Snively, Leroy Holubar

1938-39 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Assistant—Stribic
Instructor—Hazard

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani, Britton
Instructor—Snively, Holubar, Weldon Long

1939-41 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Assistant—Stribic
Instructor—Hazard

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani, Snively, Britton
Instructor—Holubar, Norman Ball

1941-42 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Assistant—Stribic
Instructor—George Uhrich, Jr.

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani, Snively, Britton
Instructor—Holubar, Ball, Dennis Barrick

1942-43 *Mathematics*
Professor—Kempner, Light
Associate—Kendall
Assistant—Stribic
Instructor—Georgia Louise Scott

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani, Snively, Britton
Instructor—Holubar, Ball, Hazard

1943-44 *Mathematics*
Professor—Kempner

Associate—Kendall
Assistant—Stribic
Instructor—Scott

Engineering Mathematics
Professor—Hutchinson
Associate—Nelson
Assistant—McMaster, Tovani, Snively, Britton
Instructors—Holubar, Ball, William Le Veque

1944-45 *Mathematics*
Professors—Kempner (Head), Kendall
Assistant—Stribic
Instructor—Georgia Louise Scott Arnett

Engineering Mathematics
Professor—Hutchinson (Head)
Associate—Nelson
Assistant—Britton, McMaster, Snively, Tovani
Instructors—Ball, Maurice F. Griffith, Holubar

1945-46 *Mathematics*
Professors—Kempner (Head), Kendall
Assistant—Stribic
Instructor—Arnett

Engineering Mathematics
Professor—Hutchinson (Head)
Associate—Britton, Nelson
Assistant—McMaster, Snively, Tovani
Instructors—Harlan Bartram, Holubar, Paul Hultquist, Lillie Walters

1946-47 *Mathematics*
Professors—Kempner (Head), Kendall
Assistant—Albert B. Farnell, Stribic
Instructor—Arnett

Engineering Mathematics
Professor—Hutchinson (Head)
Associate—Britton, Nelson
Assistant—Snively, Tovani, Karl Stahl
Instructors—George Barnes, Dennis Barrick, George Beck, Jack Bridges, Frank Casey, Amy Coats, Robert Glass, George Gregg,

Edgar Grigs, Holubar, Hultquist, Samuel Kipp, Vincent Moore, Leon Rutland, Meredith Sperline, L. Walters

1947-48 *Mathematics*
Professors—Kempner (Head), Kendall
Assistant—Farnell, Stribic
Instructor—Arnett

Engineering Mathematics
Professors—Hutchinson (Head)
Associate—Britton, Nelson
Assistant—Snively, Stahl, Tovani
Instructors—Barrick, Beck, Casey, Coats, Emil Eggert, Fred Gades, John Gawf, Glass, Gregg, Grigs, Holubar, Hultquist, Chester Karrass, Kipp, Moore, Sperline, John Wagner, L. Walters, Vernon Walters, Peggie Wiegand

1948-49 *Mathematics*
Professors—Kempner (Head), Burton W. Jones, Kendall
Assistant—Stribic

Engineering Mathematics
Professors—Hutchinson (Head)
Associate—Britton (lv), Nelson, Stahl
Assistant—Snively, Tovani, Wagner
Instructors—Barrick, Beck, Casey, Coats, Eggert, Gades, Glass, Gregg, Grigs, Holubar, Kipp, V. Moore, Rutland, Sperline, L. Walters, V. Walters

1949-50 *Mathematics*
Professors—Jones (Chairman), Kendall
Assistant—Farnell, Stribic

Engineering Mathematics
Professors—Hutchinson (Head), Britton
Associate—Nelson, Stahl
Assistant—Snively, Tovani, Wagner
Instructors—Barrick, Beck, Casey, Glass, Grigs, Holubar, Kipp, V. Moore, Rutland, Sperline, L. Walters, V. Walters

1950-51 *Mathematics*
Professors—Jones (Chairman), Kendall
Assistant—Farnell, Stribic

Engineering Mathematics
Professors—Hutchinson (Head), Britton
Associate—Nelson, Stahl
Assistant—Snively, Tovani, Wagner
Senior Instructor—Holubar
Instructors—Barrick, Beck, Casey, Glass, Grigs, Kipp, V. Moore, Rutland, Sperline, L. Walters

1951-52 *Mathematics*
Professors—Jones (Chairman), Kendall
Assistant—Albert Edrei, Stribic

Engineering Mathematics
Professors—Hutchinson (Head), Britton
Associate—Nelson, Stahl
Assistant—Barrick, Snively, Wagner
Senior Instructor—Holubar
Instructors—Kipp, V. Moore, Rutland, Sperline, L. Walters

1952-53 *Mathematics*
Professors—Jones (Chairman), S. Chowla, Kendall
Assistant—Stribic
Instructor—Robert Osserman

Engineering Mathematics
Professors—Hutchinson (Head), Britton
Associate—Nelson, Stahl
Assistant—Barrick, Snively, Tovani, Wagner
Senior Instructor—Holubar
Instructors—Robert Ellingwood, Hultquist, Kipp, R. Ben Kriegh, V. Moore, Leonard Nippe, Rutland

1953-54 *Mathematics*
Professors—Jones (Chairman), Chowla, Kendall
Assistant—Stribic
Instructors—Edward McLeod, Aboul Zirakzadeh

Engineering Mathematics
Professors—Hutchinson (Head), Britton
Associate—Nelson, Stahl
Assistant—Barrick, Snively, Tovani, Wagner
Senior Instructor—Holubar
Instructors—Ellingwood, Hultquist, Kipp, Kriegh, V. Moore, Nippe, Rutland

1954-55 *Mathematics*
Professors—Kendall (Actg. Chairman), Jones (lv), Chowla
Associate—Wolfgang Thron
Assistant—Stribic
Instructors—McLeod

Engineering Mathematics
Professors—Hutchinson (Head), Britton
Associate—Nelson, Stahl
Assistant—Barrick, Rutland, Snively, Tovani, Wagner
Senior Instructors—Holubar, Walter Varner
Instructors—Ellingwood, Hultquist, Kriegh, Nippe, Sperline, Richard Thomassen

1955-56 *Mathematics*
Professors—Jones (Chairman), Chowla, Kendall
Associate—Thron
Assistant—Stribic
Instructors—William Briggs, Robert Buschman

Engineering Mathematics
Professors—Hutchinson (Head), Britton, Stahl
Associate—Nelson
Assistant—Barrick, Hultquist, Rutland, Snively, Tovani, Wagner
Senior Instructors—Holubar, Varner
Instructors—Kathleen Anderson, John Deppe, Ellingwood, Kriegh, Carolyn Martinson, Nippe, Wilkins Rickerson, P. Jerome Short, Thomassen

1956-57 *Mathematics*
Professors—Jones (Chairman), Chowla
Associate—Thron
Assistant—Briggs, Arne Magnus, Robert McKelvey, Stribic, Zirakzadeh

Engineering Mathematics
Professors—Hutchinson (Head), Britton, Stahl (Asst. Dn.)
Associate—Nelson
Assistant—Barrick, Rutland, Snively, Tovani
Senior Instructor—Holubar
Instructors—Donald Ahlbeck, Charles Aull, Deppe, John DePree, Ellingwood, John Florence, Kenneth Hillam, Kriegh, Anna Merrill, Nippe, Maurice Nottingham, Rickerson, Short,

Palmer Smith, Thomassen, Robert Thompson

1957-58

Mathematics
Professors—Jones (Chairman), Chowla, Thron (lv)
Assistant—Briggs, Irwin Fischer, Magnus, McKelvey, Burnett Meyer, Stribic, Zirakzadeh

Engineering Mathematics
Professors—Hutchinson (Head), Britton, Stahl (Asst. Dn.)
Associate—Nelson
Assistant—Barrick, Hultquist, Rutland, Snively, Tovani, Wagner
Senior Instructor—Holubar
Instructors—Aull, Thornton Blanchard, James Bulkeley, DePree, Ellingwood, Florence, William Iverson, Kriegh, Nottingham, Rickerson, John Shue, Mildred Smith, P. Smith, Arthur Spaulding, Thomassen, Thompson

1958-59

Mathematics
Professors—Jones (Chairman), Chowla, Thron
Assistant—Briggs, Fischer, Magnus, McKelvey, Meyer, Stribic, Zirakzadeh

Engineering Mathematics
Professors—Hutchinson (Head), Britton, Stahl (Asst. Dn.)
Associate—Nelson, Rutland, Wagner
Assistant—Barrick, Hultquist, Snively, Tovani
Senior Instructors—Ellingwood, Holubar, Kriegh
Instructors—Aull, Charles Baer, Ralph Bargen, DePree, Donald Elliott, Florence, Iverson, Dale Maley, Nottingham, M. Smith, P. Smith, Spaulding, Thomassen, Thompson

1959-60

Mathematics
Professors—Chowla, Jones (lv), Thron
Associate—Briggs (Actg. Chairman)
Assistant—Fischer, Magnus, McKelvey, Meyer, Stribic, Zirakzadeh

Engineering Mathematics
Professors—Hutchinson (Head), Britton, Stahl (Asst. Dn.)
Associate—Hultquist, Rutland, Wagner
Assistant—Barrick, Snively
Senior Instructors—Ellingwood, Holubar, Kriegh
Instructors—Gilbert Ahl, Aull, Baer, Bargen, Robert Brueck,

John Corgan, DePree, Elliott, Karl Gustafson, Nottingham, Larry Schultz, M. Smith, P. Smith, Spaulding, Thomassen, Thompson

1960-61

Mathematics
Professors—Jones (Chairman), Chowla, Thron
Associate—Briggs, Magnus, Meyer, McKelvey (lv)
Assistant—Marguerite Dunton, Fischer, John Hodges, Wolfgang Schmidt, Stribic, Zirakzadeh

Engineering Mathematics
Professors—Britton (Actg. Head), Hutchinson (Actg. Dn.), Stahl (Asst. Dn.)
Associate—Rutland, Wagner
Assistant—Barrick, Snively, W. Reese Turner
Senior Instructors—Corgan, Ellingwood, Holubar, Kriegh, Thomassen
Instructors—Ahl, Aull, Baer, Bargen, John Brooks, Brueck, DePree, Elliott, Gordon Hare, James Modeer, Schultz, M. Smith, P. Smith, Spaulding, Thompson

1961-62

Mathematics
Professors—Jones (Chairman), Chowla, Thron
Associate—Briggs (lv), McKelvey, Magnus (lv), Meyer
Assistant—Fischer (lv), Hodges, David Rearick, Schmidt (lv), Stribic, R. Rebekka Struik, Zirakzadeh
Instructor—Neal Speake

Engineering Mathematics
Professors—Britton (Actg. Head), Hutchinson (Actg. Dn.), Stahl (Asst. Dn.)
Associate—Hultquist, Rutland, Wagner
Assistant—Barrick, Glenn Lewis, Snively, Turner
Senior Instructors—Corgan, Ellingwood, Holubar, Kriegh, Modeer, Thompson
Instructors—Ahl, Aull, Baer, Orason Brinker, Brooks, Brueck, DePree, Elliott, Hare, Thomassen

1962-63

Mathematics
Professors—Jones (Chairman), Chowla, Thron (lv)
Associate—Briggs, Fischer, Magnus, McKelvey, Meyer
Assistant—Charles Austin, John Halton, Hodges, J. Donald Monk, Rearick, Stribic, Struik, Zirakzadeh

Engineering Mathematics
Professors—Britton (Chairman), Hutchinson (Assoc. Dn.), Stahl (Asst. Dn.)
Associate—Hultquist, Rutland, Wagner, Irving Weiss
Assistant—Kasturi Arora, Barrick, Jerrold Bebernes, George Clements, Robert Kuller, Wayne Smith, Snively
Senior Instructors—Corgan, Ellingwood, Holubar, Kriegh
Instructor—Ahl, Brinker, Brooks, Elliott

1963-64 *Mathematics*
Professors—Chowla (lv), Jones, Thron
Associate—Magnus (Chairman), Briggs (Actg. Dn.), Fischer, Hodges, McKelvey (lv), Meyer, Stribic
Assistant—Austin, Richard Goblirsch, William Jones, Rearick, Richard Roth, Zirakzadeh

Engineering Mathematics
Professors—Britton (Chairman), Watson Fulks, Hutchinson (Assoc. Dn.), Stahl (Asst. Dn.)
Associate—Gary Meisters, Wagner, Weiss
Assistant—Arora, Barrick, Bebernes, Clements, Rex Krueger, Kuller, Snively
Senior Instructors—Corgan, Ellingwood, Holubar, Kriegh
Instructor—Elliott

1964-65 *Mathematics*
Professors—Briggs (Dean), Chowla (lv), B. Jones (lv), Thron
Associate—Magnus (Chairman), Fischer, McKelvey, Meyer, Schmidt, Stribic, Zirakzadeh
Assistant—Austin, Monk, Rearick, Roth

Engineering Mathematics
Professors—Britton (Chairman), Fulks, Hutchinson (Assoc. Dn.), Milton Wing
Associate—Meisters, Wagner, Weiss
Assistant—Arora, Barrick, Bebernes, Clements, W. Jones, Krueger, Kuller, Snively
Senior Instructors—Ellingwood, Holubar, Kriegh
Instructor—Elliott

1965-66 *Mathematics*
Professors—Briggs (Dean), B. Jones, Magnus, Schmidt, Thron
Associate—McKelvey (Chairman), Fischer, Hodges, Meyer, Monk,

Zirakzadeh
Assistant—Austin, James Moser, Rearick, Colin Hightower
Instructor—Jean Ferris

Engineering Mathematics
Professors—Fulks (Chairman), Britton, Hutchinson (Assoc. Dn.) Wing
Associate—Meisters, Wagner, Weiss
Assistant—Arora, Barrick, Bebernes, Clements, Homer Ellis, W. Jones, Krueger, Snively
Senior Instructor—Corgan, Ellingwood, Holubar, Kriegh
Instructor—Elliott

1966-67 *Professors*
Fulks (Chairman), Briggs (Dean), Hodges, B. Jones, McKelvey (lv), Robert Richtmyer, Schmidt (lv), Thron (lv), Stanislaw Ulam

Associate Professors
Fischer (lv), Henry Hermes, Albert Lundell, Meisters, Meyer, Monk, Rearick, Wagner, Weiss, Zirakzadeh

Assistant Professors
Larry Baggett, Barrick, Bebernes, Gordon Brown, Calvin Butler, Clements, Ellis, R. Kent Goodrich, Anthony Hoffman, W. Jones, Krueger, John McAlpin, Moser, Karl Norton, Terence Reed, Richard Roth, Snively, Donald Snow, Karl Usow

Senior Instructors
Ellingwood, Kriegh

Instructor
Ferris

1967-68 *Professors*
Ulam (Chairman), Briggs (Dean), Fulks (lv), Hodges, B. Jones, John Maybee, McKelvey, Meisters, Richtmyer, Schmidt, Thron

Associate Professors
Bebernes, Fischer, Hermes, Krueger (Comp. Center), Lundell, Robert MacRae, Meyer, Monk (lv), Rearick (lv), Weiss, Zirakzadeh

Assistant Professors
Baggett, Barrick, Brown, Butler, Clements, Ellis, Goodrich, Hoffman,

W. Jones, McAlpin, Moser, Norton, Reed, William Reinhardt, Aaron Rosenthal, Roth, Snively, Snow, Walter Taylor, Usow, Robert Wilhelmsen, John Williamson, F. Wesley Wilson, Jay Wolkowisky

Senior Instructors
Ellingwood, Kriegh

Instructor
Ferris

1968-69

Professors
Ulam (Chairman), Briggs (Dean), Fischer, Fulks, Hodges, B. Jones, Maybee, McKelvey, Meisters, Meyer, Monk, Richtmeyer, Schmidt, Thron

Associate Professors
Bebernes, Brown, Clements, Ellis, Karl Gustafson, Hermes, W. Jones, Krueger (Comp. Center), Lundell, MacRae, Moser, Arlan Ramsay, Rearick, Roth, Weiss, Zirakzadeh

Assistant Professors
Baggett, Barrick, Butler, Goodrich, Hoffman, McAlpin, Reed, Reinhardt, Rosenthal, Snively, Snow, W. Taylor, Usow, Wilhelmsen, Williamson, Wilson, Wolkowisky, Walter Wyss

Senior Instructors
Ellingwood, Kriegh

Instructor
Ferris

1969-70

Professors
Ulam (Chairman), Briggs (Dean), Fisher, Fulks, Hermes, Hodges, B. Jones, Lundell, Maybee, McKelvey, Meisters, Meyer, Monk, Jan Mycielski (lv), Richtmyer, Schmidt, Thron

Associate Professors
Bebernes (lv), Brown, Clements, Ellis, Gustafson, W. Jones, Krueger (Comp. Center), MacRae, Moser (lv), Ramsay, Rearick, Roth, Duane Sather, Snively, Weiss, Williamson, Wilson, Zirakzadeh

Assistant Professors
Baggett, Barrick, Butler (lv), James Foster, Merrill Goldberg, Goodrich, Hoffman (lv), Jerome Malitz, McAlpin (lv), Norton (lv), Reed (lv), Reinhardt, Rosenthal, Charles Ryavec, Roy Smith, Snow (lv), W. Taylor, Usow, Wilhelmsen, Wolkowisky, Wyss

Senior Instructors
Ellingwood, Kriegh

Instructor
Ferris

1970-71

Professors
Lundell (Chairman), Briggs (Dean), Fischer, Fulks, Hermes, Hodges, B. Jones, Maybee, McKelvey (lv), Meisters, Meyer (lv), Monk, Mycielski, Richtmyer, Schmidt (lv), Thron (lv), Ulam

Associate Professors
Baggett (lv), Bebernes, Brown, Clements, Ellis, Gustafson, W. Jones (lv), MacRae, Ramsay, Rearick, Roth, Sather, Snively, Ruth Rebekka Struik, Weiss, Williamson, Wilson (lv), Zirakzadeh

Assistant Professors
Butler, Foster, Goldberg, Goodrich, Kriegh, Maltiz, Norton (lv), Reed, Reinhardt, Rosenthal, Ryavec, Smith (lv), W. Taylor, Usow, Wilhelmsen, Wolkowisky, Wyss

Senior Instructor
Ellingwood

Instructors
Ferris, Duggirala Rao

1971-72

Professors
Lundell (Chairman), Bebernes (lv), Briggs (Dean), Fischer, Fulks, Hermes, Hodges, Maybee, Meisters, Meyer, Monk, Mycielski, Richtmyer (lv), Schmidt, Thron, Ulam (lv-sp)

Associate Professors
Baggett, Brown, Clements, Peter D. Elliott, Ellis, Goodrich, Gustafson (lv), W. Jones, MacRae, Malitz, Ramsay, Rearick, Roth, Sather (lv), Snively, Struik, Weiss, Williamson, Wilson, Wyss, Zirakzadeh

Assistant Professors
Butler (lv), Foster, Goldberg, Kriegh, Norton, Reinhardt, Rosenthal, Ryavec, Smith, W. Taylor, Usow (lv), Wilhelmsen (lv), Wolkowisky

Senior Instructor
Ellingwood

Instructor
Ferris

Lecturers
Fred Connell, John Montgomery

1972-73

Professors
Thron (Chairman), Bebernes, Briggs (Dean), Fischer, Fulks, Hermes, Hodges, Lundell (lv), MacRae (lv), Maybee, Meyer, Monk, Mycielski, Ramsay, Richtmyer, Sather, Schmidt, Ulam (lv-sp)

Associate Professors
Baggett, Brown, Clements, Elliott, Ellis, Goodrich, Gustafson, W. Jones, Malitz, Rearick, Roth, Snively, Daniel Stroock, Struik, W. Taylor, Weiss (lv), Williamson (lv), Wilson, Wyss, Zirakzadeh

Assistant Professors
Connell, Foster, Goldberg, Kriegh, Menachem Magidor, Montgomery, Norton, Reinhardt (lv), Ryavec (lv), Andrew Wang, Wolkowisky

Senior Instructors
Ellingwood, Ferris (Asst. Dn., Arts & Sciences)

1973-74

Professors
Thron (Chairman), Bebernes, Briggs (Dean), Fischer, Fulks, Gustafson, Hermes (lv), Hodges, W. Jones, Lundell, MacRae, Maybee, Meyer, Monk (lv), Mycielski, Ramsay, Richtmyer, Sather, Schmidt, Ulam (lv-sp)

Associate Professors
Baggett, Brown, Clements, Robert Easton, Elliott, Ellis, Goodrich, Malitz, Rearick, Reinhardt (lv), Roth, Stroock, Struik, W. Taylor, Weiss, Williamson, Wilson, Wolkowisky, Wyss, Zirakzadeh

Assistant Professors
Foster, Masahiko Fujiwara, Linda Hill, Kriegh, Ryavec, Martin Walter, Wang, Nancy Warren

Senior Instructor
Ellingwood, Ferris (Asst. Dn.)

1974-75

Professors
Hermes (Chairman), Bebernes, Briggs (Dean), Elliott, Fischer, Fulks, Gustafson, Hodges, W. Jones, Lundell, MacRae, Maybee, Meyer, Monk, Mycielski, Ramsay, Richtmyer (lv), Sather, Schmidt, Stroock (lv), Thron (lv), Ulam (lv-sp)

Associate Professors
Baggett, Brown, Clements (lv), Easton, Ellis (lv), Goodrich, Richard Holley, Malitz, Rearick, Reinhardt, Roth, Struik, W. Taylor (lv, sp), Weiss, Williamson, Wilson (lv), Wolkowisky, Zirakzadeh

Assistant Professors
Fujiwara, Hill, Kriegh, Richard Laver, Stephen Schiffman, Donald Silberger, Walter, Warren

Senior Instructor
Ellingwood, Ferris (Asst. Dn.)

1975-76

Professors
Hermes (Chairman), Bebernes, Briggs (Dean), Elliott, Fischer, Fulks, Gustafson, Hodges (lv), W. Jones, Lundell, MacRae, Maybee, Meyer, Monk, Mycielski, Ramsay, Richtmyer, Sather (lv), Schmidt, (lv), Stroock, Thron, Ulam (lv-sp)

Associate Professors
Baggett, Brown, Clements, Easton, Ellis, Goodrich, Holley, Malitz, Rearick, Reinhardt, Roth, Struik (lv), W. Taylor (lv-fall), Weiss, Williamson, Wilson, Wolkowisky, Zirakzadeh (lv)

Assistant Professors
Roger Alexander, Kai-Nan Chueh, Kriegh, Laver, Schiffman, Silberger, Edith Stevenson, Walter

Senior Instructors
Ellingwood, Ferris (Asst. Dn.)

1976-77

Professors

Bebernes (Chairman), Briggs (Dean), Clements, Elliott, Fischer, Fulks, Gustafson, Hermes, Hodges, W. Jones (lv), Lundell, MacRae, Maybee (lv), Meyer, Monk, Mycielski, Ramsay (lv), Richtmyer, Sather, Schmidt, Stroock, Thron, Ulam (lv-sp)

Associate Professors

Baggett, Brown, Easton, Ellis, Goodrich, Holley (lv), Malitz, Rearick, Reinhardt, Roth, Struik, W. Taylor, Weiss, Williamson, Wilson, Wolkowisky, Zirakzadeh

Assistant Professors

Alexander, Kriegh, Laver, Kenneth Rosen, Mati Rubin, Stevenson, Walter

Senior Instructors

Ellingwood, Ferris (Asst. Dn.)

1977-78

Professors

Bebernes (Chairman), Baggett, Briggs (Dean), Clements, Elliott, Fischer, Fulks, Gustafson, Hermes, Hodges, W. Jones, Lundell, MacRae, Maybee, Meyer, Monk, Mycielski, Ramsay, Richtmyer, Sather, Schmidt, Stroock, W. Taylor (lv), Thron

Associate Professors

Brown, Easton, Ellis, Goodrich, Holley, Laver, Malitz (lv), Rearick, Reinhardt, Roth, Struik, Walter (lv), Weiss, Williamson, Wilson, Wolkowisky, Zirakzadeh

Assistant Professors

Robert Burton, Kriegh (lv-sp), Rosen, Rubin, Stevenson

Senior Instructors

Ellingwood, Ferris (Asst. Dn.)

DeLong Lecturers in the Department of Mathematics

Academic Year	*Lecturer*
1962-63	Paul Halmos
1963-64	Marshall Hall, Jr.
1964-65	Edwin Hewitt
1965-66	George Polya
1966-67	Alfred Tarski
1967-68	John Milnor
1968-69	Paul Cohen
1969-70	Jürgen Moser
1970-71	Mark Kac
	Irving Kaplansky
1971-72	Abraham Robinson
1972-73	George Mackey
1973-74	Olga Taussky Todd
1974-75	Andrew Gleason
1975-76	Tosio Kato
1976-77	Hugh Montgomery
1977-78	Elias Stein

Ph.D.'s in Mathematics

1906 LEONARD, Heman B. (B.A., Michigan, 1895); [Epsteen];* Was professor and department head at the University of Arizona; Died in 1955.

1932 LEWIS, A. J. (B.A., Denver, 1907; M.A., Denver 1909); [Kempner]; Was professor at the University of Denver; Died in 1961.

1936 BRITTON, Jack R. (B.A., Clark University, 1929); [Kempner]; Is Professor Emeritus at the University of South Florida.

1939 BEATY, Marjorie (B.A., Rochester, 1928; M.A., Brown University, 1929); [Kempner]; Is professor emeritus at South Dakota University.

JOHNSON, L. L. (B.A., University of Colorado, 1928; M.A., University of Colorado, 1933); [Kempner]; Is presently at Wesleyan University, Connecticut.

1951 HUNT, Burrows (B.A., Princeton, 1938); [B. Jones]; Is presently professor emeritus at Reed College.

1953 BRIGGS, William E. (B.A., Morningside, 1948; M.A., University of Colorado, 1949); [B. Jones]; Is presently Professor at University of Colorado and Dean of the College of Arts & Sciences.

1954 MARSH, Donald C. B. (B.A., Arizona, 1947; M.A., Arizona, 1948); [B. Jones]; Is presently a professor at Colorado School of Mines.

MC CROSSEN, Garner (B.A., M.A., Wyoming, 1948, 1949); [Britton]; Went to Control Data Corporation.

RUTLAND, Leon D., Jr. (B.A., M.A., East Texas, 1940, 1941); [Britton]; Is professor at Virginia Polytechnic Institute.

1955 MIENTKA, Walter E. (B.A., Massachusetts, 1948; M.A., Columbia, 1949); [Chowla]; Is presently a professor at the University of Nebraska.

1956 BUSCHMAN, Robert G. (B.A., Reed, 1949; M.A., Oregon, 1951); [Britton]; Is presently a professor at the University of Wyoming.

HANNA, James R. (B.A., M.A., Kansas State Teachers College, 1939, 1940); [Britton]; Is presently a professor at University of Wyoming.

MC KENZIE, Harvey C. (B.A., M.A., Wisconsin, 1930, 1947); [Edrei]; Is presently a professor at University of Wisconsin, Oshkosh.

1959 HOUSEHOLDER, James E. (B.A., M.A., Arizona, 1952, 1953); [Chowla]; Is presently a professor at Humboldt State University.

1960 CORREIA, Frank B. (B.A., Naval Academy, 1944; M.A., New Mexico, 1953); [Chowla]; Is now a professor at Rhode Island College.

*Ph.D. Advisor

DUNTON, Marguerite E. (B.A., Wisconsin, 1947; M.A., Radcliffe, 1954); [Chowla]; Is now a professor at California State University, Sacramento.
DUQUETTE, Alfred L. (B.A., Massachusetts, 1948; M.A., Columbia, 1950); [Bateman]; Is now a professor at West Georgia College.
GRUDIN, Arnold (B.A., New York University, 1948; M.A., Columbia, 1949); [Edrei]; Is presently a professor at Denison University.
LANGE, Leo J. (B.A., Regis, 1952; M.A., University of Colorado, 1956); [Thron]; Is now an associate professor at the University of Missouri.
NAFOOSI, Abdul-Aziz K. (B.A., Bagdad, 1944; M.A., Michigan, 1950); [Chowla]; Is now a professor at Chicago State University.

1961 BARDWELL, George E. (B.A., M.A., Colorado, 1943, 1949); [Crowe]; Is presently an associate professor at the University of Denver.
CHOWLA, Paromita (B.A., M.A., Colorado, 1954, 1957); [Chowla]; Is now an associate professor at Pennsylvania State University.

1962 AULL, Charles E. (B.A., Columbia, 1949; M.A., Oregon, 1953); [Thron]; Is now a professor at Virginia Polytechnic Institute.
COOK, Clarence H. (B.A., M.A., Iowa, 1948, 1950); [Thron]; Is now a professor at the University of Maryland.
DE PREE, John D. (B.A., Hope College, 1955; M.A., Colorado, 1958); [Thron]; Is now a professor at New Mexico State University.
EDGAR, Hugh M. D. (B.A., M.A., Alberta, 1956, 1958); [Chowla]; Is presently a professor at San Jose State University.
HILLAM, Kenneth L. (B.A., M.A., Utah, 1949, 1956); [Thron]; Is presently a professor at Brigham Young University.
JORDAN, James H. (B.A., S. Oregon College, 1953; M.A., Oregon, 1958); [Chowla]; Is now a professor at Washington State University.
WALUM, Herbert (B.A., Reed, 1958); [Chowla]; Is now an associate professor at Ohio State University.

1963 BEIRSTEDT, Ronald G. (B.A., Colorado College, 1957); [Chowla]; Is presently an assistant professor at the University of New Mexico.
SEGAL, Sanford L. (B.A., Wesleyan, 1958); [Chowla]; Is now an associate professor at the University of Rochester.
THOMPSON, Robert G. (B.A., M.A., Nebraska, 1948, 1950); [B. Jones]; Is presently a professor at Eastern Washington University.

1964 DRAKE, David (B.A., Harvard, 1952); [Thron]; Is now an associate professor at the University of Florida.
GUENTHER, Ronald B. (B.A., M.A., Oregon State, 1959, 1962); [Fulks]; Is now an associate professor at Oregon State College.
HARE, Gordon B. (B.A., Columbia, 1951; M.A., Colorado, 1954); [B. Jones]; Is now a professor at Walla Walla College.
HURSCH, Jack L., Jr. (B.A., M.A., Denver, 1951, 1953); [Thron].
PORTER, A. Duane (B.A., M.A., Michigan State, 1960, 1961); [Hodges]; Is presently a professor at the University of Wyoming.

WUNDERLICH, Marvin C. (B.A., Concordia, 1959); [Briggs]; Is now a professor at Northern Illinois University.

1965 BIRNBAUM, Sidney (B.A., M.A., NYU, 1948, 1949); [McKelvey]; Is now an associate professor and dean at California State Polytechnic College.
BURLING, James P. (B.A., Grinnell, 1952; M.A., Albany, 1957); [Zirakzadeh]; Is now a professor at SUNY, Oswego.
DAVIS, Henry W. (B.A., Rice, 1959; M.A., Colorado, 1961); [Meisters]; Is now an associate professor at Wright State University.
ELDRIGE, Klaus E. (B.A., Hardin-Simmons, 1960; M.A., Oklahoma St., 1962); [Fischer]; Is now an associate professor at Ohio University.
KEISER, Victor H., Jr. (B.A., Lawrence, 1951; M.A. Colorado, 1962); [Roth]; Is presently a professor at Whitman College.
MOUSOUVIS (Morez), Nicholas S. (B.A., Cal Tech, 1961; M.A. Colorado, 1963); [Thron]; Is presently an associate professor at Humboldt State University.
POOLE, Michael G. (B.A., Oregon State, 1961); [Fulks]; Is now at the science program at ARO.
SHOTWELL, David A. (B.A., M.A., Colorado, 1954, 1959); [McKelvey]; Is now at the National Bureau of Standards.
VAIDYA, Arunkumar M. (B.A., M.A., Bombay, 1956, 1958); [Chowla]; Is presently an associate professor at the University of Gujarat.

1966 CALLAS, Nicholas P. (B.A., Naval Academy, 1954; M.A., Colorado, 1959); [Thron]; Is now an assistant professor at Colorado School of Mines.
DAVIS, Ronald W. (B.A., Colorado, 1958); [Hodges]; Is presently an associate professor at San Diego State College.
DOOHER, Terrence E. (B.A., Regis, 1960; M.A., Notre Dame, 1962); [Thron]; Is now an associate professor at Metro State College.
ELLIOTT, Donald D. (B.A., M.A., Colorado, 1958, 1961); [Meisters]; Is now chairman at the University of Northern Colorado.
FRANZEN, Norman R. (B.A., Oregon State, 1960); [Magnus]; Is now an assistant professor at Oregon State University.
GIBSON, Archie G. (B.A., Colorado, 1962); [McKelvey]; Is presently an associate professor at the University of New Mexico.
HAGIN, Frank G. (B.A., Bethany Naz., 1954; M.A., SMU, 1962); [Wing]; Is now associate professor at the University of Denver.
LA GRANGE, Robert H. (B.A., M.A., Colorado, 1960, 1963); [Monk]; Is now associate professor at the University of Wyoming.
MC KENZIE, Ralph N. D. (B.A., Colorado, 1963); [Monk]; Is now a professor at the University of California, Berkeley.
MODEER, James R. (B.A., M.A., Colorado, 1953, 1958); [McKelvey]; Is now an associate professor at University of Colorado, Colorado Spgs.
REED, Ellen E. (B.A., Gonzaga, 1962; M.A., Colorado, 1964); [Thron]; Is presently an associate professor at University of Massachusetts.

SMITH, Robert A. (B.A., M.A., Sacramento State, 1960, 1961); [Chowla]; Is presently an associate professor at University of Toronto.

STEVENSON, Frederick D. (B.A., Carleton College, 1960; M.A., Colorado, 1963); [Thron]; Is now an assistant professor at the University of Arizona.

1967 COMER, Stephen D. (B.A., Ohio State, 1962; M.A., Berkeley, 1964); [Monk]; Is now at The Citadel as an associate professor.

EGGERT, Norman H. (B.A., DePauw, 1961; M.A., Utah State, 1963); [Fischer]; Is now an associate professor at Montana State University.

GAINES, Robert E. (B.A., M.A., Illinois, 1963, 1963); [Bebernes]; Is presently a professor at Colorado State University.

NESENBERGS, Martin (B.A., Denver, 1952; M.A., NYU, 1958); [Weiss]; Is now at ESSA in Boulder.

PASSI, Harsh Anand (B.A., M.A., Panjab, 1959, 1961); [Schmidt]; Is now working at NCAR in Boulder.

1968 BOLAND, Willard R. (B.A., Davidson C., 1959; M.A., Wm & Mary, 1963); [Wing]; Is now at Clemson University.

DUKE, John W. (B.A., N. Texas State, 1959; M.A., Texas Tech., 1961); [B. Jones]; Is presently a professor at Angelo State University.

JOHNSON, James S. (B.A., Berkeley, 1965); [Monk]; Is presently running an appliance business in Boulder.

SNELL, Robert I. (B.A., N. Michigan, 1959; M.A., Michigan, 1960); [W. Jones]; Is an associate professor at University of Puget Sound.

1969 BANCROFT, Peter (B.A., Amherst College, 1965); [Hermes]; Is a Right of Way Agent in Concord, California.

BRASE, Charles H. (B.A., M.A., Colorado, 1964, 1967); [Fischer]; Is an assistant professor at Regis College.

DONOVAN, George S. (B.A., Massachusetts, 1963; M.A., Colorado, 1966); [Rearick]; Is an assistant professor at Metro State College.

FINKELSTEIN, Harold S. (B.A., Cornell U., 1961; M.A., Michigan, 1963); [Struik]; Is now an assistant professor at Emory University.

HARTMAN, William J. (B.A., Colorado, 1955); [Fulks]; Is now at NOAA ITSA.

JEFFERSON, Thomas H. (B.A., Rensselaer, 1963; M.A., N. Carolina, 1965); [Thron]; Is now at Sandia Corporation in California.

MANDELL, Michael (B.A., M.A., Colorado, 1959, 1963); [Magnus]; Is now an auditor for the State of Colorado.

LATHROP, James F. (B.A., M.A., Oregon State, 1961, 1963); [Krueger].

NIELSEN, Gale H. (B.A., S. Dakota, 1963; M.A., Colorado, 1966); [Rearick]; Is now an assistant professor at South Dakota State University.

OLIVER, James M. (B.A., M.A., LSU, 1955, 1957); [Maybee]; Is now at Louisiana State University.

RAMALEY, William C. (B.A., Ohio State, 1961; M.A., Colorado, 1963); [B. Jones]; Is now an associate professor at Ft. Lewis College.

SHADER, Leslie E. (B.A., M.A., Colorado State, 1957, 1961); [Hodges]; Is an associate professor at the University of Wyoming.

STONE, Michael G. (B.A., Wesleyan U., 1960; M.A., LSU, 1962); [Monk]; Is an associate professor at the University of Calgary.

HARTZMAN, Carl S. (B.A., C.C. of New York, 1963; M.A., Purdue, 1965); [Hermes]; Is an assistant professor at Dalhousi University.

1970 ADAMS, John C. (B.A., M.A., Wyoming, 1965, 1967); [Fischer]; Is now working at NCAR in Boulder.

CHUNG, Kyong S. (B.A., Korean Military Acad., 1955; M.A., Hawaii, 1965); [B. Jones]; Is presently at Kapiolani Community College.

CURRIM, Ahmed N. (B.A., Michigan, 1961; M.A., Harvard, 1963); [Richtmyer]; Is now at Western Carolina University.

FRAKER, Ross M. (B.A., M.A., Colorado, 1964, 1965); [Bebernes]; Is at the University of Washington Dental School.

INGRAM, Steven K. (B.A., Bowdoin C., 1965; M.A., Colorado, 1968); [Bebernes]; Is an assistant professor at Norwich University.

LARSON, Roland E. (B.A., Lewis & Clark, 1966; M.A., Colorado, 1968); [Thron]; Is an associate professor at Penn State University.

LEE, Robert A. (B.A., Reed, 1964); [Schmidt].

MAYNARD, Hugh B. (B.A., Cal. Tech., 1964; M.A., Colorado, 1967); [Goodrich]; Is now at the University of Texas, San Antonio.

SHONKWILER, Ronald W. (B.A., Cal. St. Poly., 1964; M.A., Colorado, 1967); [McKelvey]; Is now associate professor at Georgia Tech.

SIKONIA, William G. (B.A., Montana State, 1964; M.A., Colorado, 1968); [Gustafson]; Is now an associate professor at Georgia Tech.

SWARZTRAUBER, Paul N. (B.A., U. of Illinois, 1959; M.A., Colorado, 1966); [Richtmyer], is how working at NCAR in Boulder.

ANDIMA (Zimmerman), Susan J. (B.A., SUNY, 1965; M.A., Colorado, 1968); [Thron]; Is now an associate professor at C. W. Post College.

1971 AHUJA, Mangho (B.A., Punjab, 1954; M.A., Rochester, 1966); [Meisters]; Is now at SEMO State College as an associate professor.

AREHART, Raymond A. (B.A., M.A., Colorado, 1964, 1969); [Meisters]; Is now an assistant professor at Texas A & I.

CARLSON, David L. (B.A., Carleton, 1963; M.A., Michigan, 1965); [Hodges]; Is now in the Colorado Agricultural Department.

CHUAN, Jen-Hung (B.A., Nat'l Taiwan, 1964; M.A., Colorado, 1967); [Williamson]; Is now in Jonson City, Texas.

DAVIS, Arlo D. (B.A., Wm. Penn, 1962; M.A., W. Michigan, 1966); [Wilson]; Is now in Indiana, Pennsylvania.

ELDERKIN, Richard H. (B.A., Whitman, 1967; M.A., Colorado, 1968); [Wilson]; Is now an assistant professor at Pomona College.

FIELD, David A. (B.A., Bowdoin, 1965; M.A., Oakland, 1966); [W. Jones]; Is now an assistant professor at College of the Holy Cross.

PACHOLKE, Kenneth L. (B.A., Northland, 1960; M.A., Colorado, 1965); [Fischer]; Is an assistant professor at Northland College.

PHILLIPS, Edward C., Jr. (B.A., Colorado, 1966); [Ramsay].

WARREN, Richard H. (B.A., Naval Acad., 1956; M.A., Michigan, 1964); [Thron]; Is an associate professor at the University of Nebraska, Omaha.

1972 ARORA, Harbans (B.A., Punjab, 1955; M.A., Colorado, 1968); [Maybee]; Is now in Monsul, Iraq.

RAO, Duggirala (B.A., Govt. Arts C., 1954; M.A., Indiana Inst. of Sci., 1965); [Gustafson]; Is now at the Universidad de Valle, Cali, Colombia.

ALBIS-GONZALEZ, Victor S. (B.A., Colombia, S.A.); [MacRae]; Is now President, U. de Sucre, Sincelejo, Colombia.

GALLAGHER, Leonard J. (B.A., St. John's 1965; M.A., Colorado, 1968); [Ulam]; Is an assistant professor at Catholic U. of America.

KELLEY, Walter G. (B.A., Geo. Tech., 1968; M.A., Colorado, 1969); [Bebernes]; Is now at the University of Oklahoma.

LEISE, James A. (B.A., M.A., Colorado, 1966, 1968); [Lundell]; Is now at NBS in Boulder.

LUFT, Philip E. (B.A., Cornell, 1961; M.A. Colorado, 1968); [McKelvey]; Is now in Lynchburg, Virginia.

EWING, Donald (B.A., M.A., Colorado, 1962, 1965); [Wilson]; Is now working for the U.S. Department of Commerce in Boulder.

GANUZA-ZAMOR, Edgar (B.A., El Salvador, 1966; M.A., Colorado, 1970); [Williamson]; Is at the Universidad de Oriente, Cumana, Venezuela.

1973 KARLOF, John K. (B.A., SUNY, 1968; M.A., Colorado, 1970); [Roth]; Is now at the University of Nebraska at Omaha.

KERR, Steven D. (B.A., Portland St., 1966: M.A., Colorado, 1968); [Brown]; Is an assistant professor at Weber State College.

CLARE, Fred J. (B.A., Tulsa, 1965; M.A., Colorado, 1968); [Monk]; Is working at NCAR.

COUGHLIN, James P. (B.A., Fordham, 1960; M.A., Columbia, 1962); [Richtmyer]; Is at the U.S. Naval Weapons Laboratory.

HAYS, Michael D. (B.A., M.A., Purdue, 1965, 1967); [Roth]; Is now working for an insurance company in Massachusetts.

HOTOVY, Steven G. (B.A., Notre Dame, 1968; M.A., Colorado, 1970); [Hermes]; Is working for Computer Science Corporation.

MARKANDA, Raj (B.A., M.A., Punjab, 1959, 1961); [MacRae]; Is now at the U. de Los Andes, Merida, Venezuela.

SANERIB, Richard A. (B.A., St. Anselems, 1965; M.A., Colorado, 1969); [Monk]; Is now at Lawrence College as an assistant professor.

1974 CARLTON, Eloise H. (B.A., Middlebury, 1965; M.A., Colorado, 1969); [Ramsay, Kleppner]; Is now in medical school.

GOETTGE, Robert T. (B.A., Penn St., 1969; M.A., Colorado, 1972); [Foster]

VALENT, Richard A. (B.A., Colorado, 1967); [Thron]; Is now working at NCAR.

MENDEZ, Celestina G. (B.A., Benedictine, 1965; M.A., Colorado, 1968); [Ulam]; Is now an assistant professor at Metro State College.

SPARKS, Paul R. (B.A., Colorado, 1969); [Foster]; Is now in Texas.

1975 BADGER, Lee W. (B.A., Missouri, 1968; M.A., Colorado, 1970); [Mallitz]; Is an assistant professor at Southern Illinois University.

CAMPBELL, Robert C. (B.A., Trinity, 1970; M.A., Colorado, 1972); [Maybee]; Is now an assistant professor at Rockhurst College.

CAVENDER, James A. (B.A., Colorado, 1968); [Williamson]; Is an assistant professor at Utica College in New York.

MERS, Robert C. (B.A., U. of Texas, 1964; M.A., Illinois, 1966); [Strulk]; Is an assistant professor at North Carolina A & T.

ORI, Ramesh G. (B.A., U. College, S. Africa, 1966); [Thron]; Is a senior lecturer at Durban Westville.

1976 FABEC, Raymond D. (B.A., Colorado, 1968); [Ramsay]; Is an assitant professor at Louisiana State University.

KOBER, Wolfgang (B.A., Colorado, 1969); [Maybee]; Is now at Control Data in Minnesota.

MARTIN, Thomas D. (B.A., Minnesota, 1964); [Ellis], assistant professor at the University of Portland.

DONOVAN, Timothy P. (B.A., Regis, 1963; M.A., Oklahoma, 1967); [Hodges]; Is an assistant professor at Metro State College in Denver.

RATLIFF, Michael I. (B.A., Pacific Union, 1967; M.A., Colorado State, 1969); [Schmidt]; Is now an assistant professor at Northern Arizona University.

1977 DIESTO, Severino (B.A., Mindanao State, 1969; M.A., Colorado, 1972); [Thron]; Is now at Silliman University in the Philippines.

EVERTS, Franklin F. (B.A., Cal. Tech., 1970); [Schmidt]; went to Computer Corporation in Washington, D.C.

HUMBURG, Fredrick W. (B.A., Michigan, 1969; M.A., Colorado, 1971); [Brown]; Is now employed by the Dade County Florida Public Schools.

KERRIGAN, Thomas C. (B.A., Colorado, 1968); [Stroock]; Is at Batelle Northwest in Washington.

MORGENSTERN, Carl F. (B.A., Princeton, 1970; M.A., Colorado, 1973); [Reinhardt]; Is an assistant professor at the U. of Calif., Santa Cruz.

SPACKMAN, Kenneth W. (B.A., Penn State, 1969; M.A., Colorado, 1974); [Schmidt]; Is now an assistant professor at the U. of Kentucky.

BATESON, Carol A. (B.A., Wellesley, 1967; M.A., Colorado, 1973); [W. Taylor]; Is an assistant professor at Colorado Women's College.

JOY, Kenneth I. (B.A., M.A., UCLA, 1968, 1972); [Baggett]; Is an assistant

professor at Northern Michigan University.

LOATS, James T. (B.A., Oklahoma State, 1968; M.A., Ohio, 1970); [Monk]: Is an assistant professor at Southern Illinois University.

RHOADES, Clark P. (B.A., Whitman, 1968); [Goodrich]; Is an assistant professor at Loyola University in New Orleans.

BARRAZA, Daniel M. (B.A., Reed, 1970; M.A., Colorado, 1973); [Gustafson]; Is an assistant professor at Southern Illinois University.

LYNCH, James (B.A., MIT, 1969; M.A., Colorado, 1973); [Mycielski]; Is an assistant professor at Clarkson College.

1978 CERVANTES-S., Rafael (B.A., Tec. de Monterrey, 1970; M.A., Colorado, 1975); [Hermes]; Is returning to Mexico.

TALAGA, Paul C. (B.A., Colorado, 1969; M.A., Colorado, 1974); [Bebernes].

Master's Degrees in Mathematics until 1948

Year *Name & Thesis Title*

1900 GIFFIN, Frank Albee (B.A., University of Colorado, 1899)

1901 NEIKIRK, Lewis J. (B.S., University of Colorado, 1898)

SMITH, Alwyn C. (B.S., University of Colorado, 1894) Hyperbolic curves of nth order

1902 EMCH, Hermann (B.A., University Bern, Lehramtsschule, 1898) Realization of collineations in a plane by linkages

AKERS, Oskar Perry (B.A., University of Colorado, 1900)

1903 ELDEN, Maud (B.A., University of Colorado, 1902)

1906 CARSTENS, Ruby Lily (B.A., University of Colorado, 1905) Definition of quarternions by independent postulates

1908 EATON, Durward L. (B.S., Earlham, 1907) A method for calculating simultaneously all roots of an equation

1909 SMITH, Guy W. (B.S.-EE-, University of Colorado, 1908)

1910 SHUFELT, Gladys Elizabeth (B.A., Union College, 1907) Life and work of Sir Isaac Newton

1913 BELSER, Louise (B.A., University of Colorado, 1911) Pieces of curves

1914 SNELL, Lolita (B.A., University of Colorado, 1914) Colorado Mathematicians

KENDALL, Claribell (B.A., University of Colorado, 1918) Preassociative syzygies in linear algebra

1921 HILL, William H. (B.A., University of Colorado, 1918) The origin and development of trigonometry

1922 ALDEN, Ruth V. (B.A., Grinnell College, 1915) The use of series in mathematical physics

CLARK, Andrew G. (B.A., University of Colorado, 1921) The resistance integral of Euler–(Light)

HOOVER, Borden P. (B.A., Baker University, 1918) The history and development of the catenary

HARGETT, Anderson J. (B.A., Transylvania, 1897) The algebra of the Hindus and Arabs and its influence upon the early algebra of Europe

BAUKMAN, Sister Mary Bernadita (B.A., Creighton, 1917) Transcendence of Pi

1924 MOORE, Jane C. (B.A., Mississippi State College for Women, 1907) Certain properties of a particular fourth order curve

WALDEN, Emory E. (B.A., Hendrix College, 1922) Fundamental theorem of algebra

TROLINGER, Lelia (B.A., University of Colorado, 1920) Differential equations of the second order, their development and application

STEVENSON, Perry L. (B.A., University of Colorado, 1921) Systems of coordinates, their development and use

1925 LOWE, Burdett H. (B.S., College of A & M, University of Montana, 1921) On the cubic equation with one unknown

1926 BERRY, William J. E. (E. Met. Colorado School of Mines, 1924) The analytic continuation of functions of a complex variable

MCGINLEY, Margaret (B.A., University of Denver, 1923) The development and computation of logarithms

STALEY, Raymond C. (B.A., University of Colorado, 1916) A history and importance of uniform convergence of infinite series

KENDALL, Florence (B.A., University of Colorado, 1913) The problem of two and three bodies in celestial mechanics

1927 EHRENBERG, David (B.A., University of Denver, 1925) The differential equations of linear heat flow in two heterogeneous media

1928 KARNOW, Herman (B.A., University of Colorado, 1926) On continued fractions and the elementary theory of numbers (Kempner)

RICHERT, David (B.A., Oberlin College, 1909) Definite integers in the plane of complex numbers (Kempner)

BLACK, Lovick G. (B.A., University of Colorado, 1927) The fundamental properties of the gamma function as derived from the integral definition (Kempner)

1929 RANDALL, Albert W. (B.A., Alcorn A & M College, 1916) Separation and computation of imaginary roots of algebraic equations (Kempner)

MIDDLEMISS, Ross R. (B.S., University of Colorado, 1926) A comparative study of methods of summing divergent series (Hutchinson)

1930 MARCH, Guy E. (B.S.-EE- South Dakota School of Mines, 1922) Some coordinate systems and their applications (Light)

HACKER, Sidney G. (B.A., University of Colorado, 1929) The fundamental theory of operational calculus (Light)

WESTERFELD, Everett (B.A., University of Colorado, 1928) Upper and lower bounds for the zeros of polynomials (Kempner)

1931 FOLK, Pauline Frances (B.A., University of Colorado, 1930) Methods for the determination of orbits in theoretical astronomy (Hutchinson)

PURCELL, Edwin J. (B.A. University of Arizona, 1929) The properties of the foci of the general algebraic plane curve (Kendall)

1932 RICE, Ethel (West Texas State Teachers College, 1926) Determination of the foci of special plane algebraic curves (Kendall)

1933 BARNETT, Evelyn Louise (B.A. Nebraska West, 1931) The theory of determinants and their relation to the solution of systems of linear equations (Kempner)

JOHNSON, Laura Louise (B.A., University of Colorado, 1928) On transfinite numbers (Kempner)

1934 COUZENS, Frances Eleanor (B.A., University of Colorado, 1933) Some differential equations and examples of their applications (Light)

GUARD, Harris T. (B.S., Colorado State University, 1930) Elliptic integrals (Light)

MADISON, Marion Leslie (B.S., Colorado State University, 1931) Number systems (Kempner)

1935 LINDAHL, Clarence H. (B.S., Kearney State Teachers College, 1929) The theory of finite substitution groups and their application to the solution of algebraic equations (Light)

HILL, Henry I. (B.S., West Texas State College, 1931) Certain matrices and matrix equations (Light)

EVANS, Ruth K. (B.A., Sterling College, 1924) Rational triangles (Kempner)

ANDERSON, Roscoe V. (B.A., Hastings College, 1925) Analytic functions of a complex variable (Hutchinson)

RAINVILLE, Earl (B.A., University of Colorado, 1930) On the conduction of heat in concrete dams (Hutchinson)

1936 ELLIOTT, Archibald W. (B.S., University of Nebraska, 1924) Conformal mapping (Kendall-Hutchinson)

1937 HOFFMAN, Ruth (B.A., University of Colorado, 1936) On the development and use of the concepts of the infinitesimal calculus before Newton and Leibniz (Kempner)

OLPIN, J. Lloyd (B.A., Brigham Young University, 1925) Convergence and evaluation of infinite integrals (Hutchinson & Kempner)

1938 KELLUM, Cecil (B.A., Friends University, 1929) Uniform convergence of infinte series (Hutchinson & Kempner)

POWELL, Lily B. (B.A., St. Mary's College, 1916) Tests for convergence and divergence of infinite series (Kempner)

BROWN, Bryce Kenneth (B.A., S. W. College, 1931) Analysis of various methods of defining trigonometric functions (Kempner)

1939 MITCHELL, William W. (B.S., University of Arizona, 1938) A geometric interpretation of linear transformations in real and complex variables (Kempner)

1940 JOHNSON, Leta E. (B.A., B.S., Texas State College for Women, 1930) On binomial congruences and binomial equations (Kempner)

1941 UHRICH, George E. (B.S., University of Washington, 1939) On envelopes of families of straight lines, etc. (Kempner)

SPECHT, Edward G. (B.S., Walla Walla, 1939) Geometric representation of multiple valued analytic functions of a complex variable (Hutchinson)

1942 BOCK, Walter William (B.S., S.E. Missouri State Teachers College, 1933) On the pathological functions of real variables (Kempner)

HURT, William C. (B.A., New Mexico Highlands, 1933) The Euclidean algo-

rithm, historical background and applications (Kempner)

1944 FREDERICKSON, Elvie (B.A., Williamette College, 1943) Transformations of finite series (Kempner)

LE VEQUE, Marion Fenton (B.A., Barnard College, 1939) Plane pedal curves (Kendall)

1945 BRONFENBRENNER, Jean Andrus (B.A., University of Chicago, 1939) Direct and interactive methods of solving normal equations and inverting the correlation matrix (Stribic)

1948 WARING, John W. (B.S., University of Colorado, 1947) On the Laplace partial differential equation in three dimensions (Farnell)

WALTERS, Lillie C. (B.A., University of Colorado, 1933—M.S. (Education), University of Colorado, 1936) Ruler constructions in projective geometry (Kendall)

CULPEPPER, Gideon A. (B.A., University of Colorado, 1947) La Grange's equations in dynamics (Farnell)

Advanced Degrees Granted

Year	*M.A.*	*M.S.*	*Ph.D.*
1900	1		
1901	2		
1902	2		
1903	1		
1906	1		1
1908	1		
1909	1		
1910	1		
1913	1		
1914	2		
1921	1		
1922	5		
1924	4		
1925	1		
1926	4		
1927	1		
1928	3		
1929	2		
1930	3		
1931	2		
1932	1		1
1933	2		
1934	3		
1935	5		
1936	1		1
1937	1		
1938	5		
1939	1		2
1940	1		
1941	2		
1942	2		
1944	2		
1945	1		

1948	3		
1949	2		
1951			1
1953	5		1
1954	2		3
1955	3		1
1956	3		3
1957	2		
1958	2		
1959	5		1
1960	2	11	6
1961	1	4	2
1962	5	4	7
1963	6	8	3
1964	3	3	6
1965	6	12	9
1966	9	16	13
1967	6	12	5
1968	27	19	4
1969	13	5	14
1970	16	8	12
1971	14	13	10
1972	20	9	9
1973	17	8	8
1974	11	12	5
1975	9	12	5
1976	7	4	5
1977	14	10	12
1978	4	7	2

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