

THE UCR CHEMISTRY DEPARTMENT

An anecdotal history from the undocumented memories
of several players for the years 1954 - 1984

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I. The Formative Period

The teaching campus at the University of California at Riverside originated as a small liberal arts college operating within the framework of a large University system with a traditional broad-range emphasis on research, instruction, and service activities. It was composed of four divisions, one of which, Physical Sciences, included the chemistry discipline.

The founding Division Chairman of Physical Sciences was W. Conway Pierce, after whom the present Chemistry Building was named. Conway was reared in Kentucky, and received his bachelors degree from Georgetown College, Lexington, Kentucky. His Ph.D. was awarded by the University of Chicago. He taught at the University of Chicago during the 1930's and mid-1940's. During WWII he was active in research projects for the Chemical Warfare Service. After WWII he was asked to reestablish the Chemistry Department at Pomona College which he did most successfully. Founding Provost Gordon Watkins asked him to establish the Division of Physical Sciences at the then-new Riverside campus College of Letters and Science. Conway remained Division Chair until the unit was broken up into departments. He taught (primarily) Chemistry 1 and analytical chemistry as well. After the UCR Division of Physical Sciences was converted to departments, he consulted for the new Irvine campus in the establishment of its physical science departments. He received the Tolman Award of the Southern California Section of the American Chemical Society. He was co-author, originally with Ed Haenish and later with Don Sawyer, of one of the classic texts in analytical chemistry. Conway retired in 1962; after a few retirement years in Riverside, he moved to Oregon where he died.

Pierce was famous for practical jokes at Pomona College and carried something of this tradition to UCR when he arrived. In Chemistry 1, one of his standard demonstrations was to detonate electrically a small perchlorate/sulfur mixture at the end of the lecture on nuclear energy and The Bomb. Administrators remember his frequent appeals to thermodynamics in budget discussions or the comparison of a student's study list to a restaurant menu. Conway was an astute academic politician and played a major role in developing campus policies as well as in influencing the selection of chancellors. Early members of the faculty remember his attempt to try to "humanize" our grading practices and attempts to transfer students from science to other parts of the campus without destroying their grade points unnecessarily.

His research covered a surprising number of areas starting at Chicago with X-ray diffraction on liquids and photochemistry, as examples. At Pomona he worked in gas adsorption on charcoal surfaces, and he continued this work at UCR even after his retirement.

George Helmkamp was the first chemist aside from Conway Pierce to move to UCR. He received his B.A. from Wartburg College, Iowa, an MS from the Claremont Graduate School, and his Ph.D. from Cal Tech. After a year as a chemistry instructor at Pomona College he was invited to join the faculty at UCR. When he arrived in 1953, the buildings for the new Letters and Science College had not been completed, so the first six months of work were spent in temporary quarters.

George taught the first classes in organic chemistry and introduced the Physical Sciences Survey course. He has been involved in planning and teaching all organic chemistry courses until

his retirement in 1981. He was chairman of the Department from 1969 to 1973, and also served as Associate Dean of Letters and Science and later, Natural and Agricultural Sciences. For his teaching he was awarded the Academic Senate Award in Teaching and the first Graduate Student Association Teaching Award. His research evolved from acetylenes to optically active deuterium compounds, DNA conformation studies, and small-ring sulfur and nitrogen heterocycles. In retirement he has become heavily involved with The Nature Conservancy and played a key role in the establishment of its reserve in Big Morongo Canyon.

No account of Helmkamp would be complete without some attempt to portray his Renaissance-man type personality. He was a pianist of sufficient talent to make professional music a real possibility in college. Other interests in which he has excelled are tennis, glassblowing, bridge, fishing, rockhounding, bird identification and botany (he taught himself the elements of botanical systematics to identify all common plants in the Southwest deserts and, with Frank Vasek, organized and helped teach the Biology Spring Wildflowers course). His skill and nastiness in the card game of hearts are legendary with those who participated in the noon hour games in the departmental library.

Preparing the Physical Sciences building for the opening of classes in January of 1954 was much like receiving a birthday present consisting of a do-it-yourself kit without the tools. The excitement of being given an unusual, even unique, opportunity was quickly lost in the realization that here was a laboratory building without a beaker, a campus without grass and trees, and a curriculum before any students.

The Division Heads, including Conway Pierce in Physical Sciences, operated out of what was the residence of the Director of the Citrus Experiment Station. Professor Homer Chapman's Greenhouse #6 provided the office space for Physics and Chemistry Instructors Wild and Helmkamp, and Entomology Professor Francis Gunther's laboratory was the site of the first experiments that led to a publication originating from Chemistry.

The first goal was to outfit the Chemistry wing from a budget that was, to put it lightly, just slightly larger than the government's allocation for the Riverside County submarine base. With weekly trips to War Surplus in Los Angeles and donations of outdated glassware from UCLA and elsewhere, the laboratories did become operational in time for the opening of classes. The largest pieces of equipment in the department were a Beckman DU spectrophotometer and a manual Rudolph polarimeter, but there were 24 double-pan balances whose history includes being rescued after midnight from a leaky tin storage shed during a severe Fall rain.

Physical Sciences came equipped with one standard telephone, but fortunately raceways were included that allowed us to install a set of war surplus, handcranked field phones for interoffice communication. In retrospect, other advantages and disadvantages stand out. Parking was free, anywhere, usually in dirt lots; equipment packing crates became useful substitutes for sidewalks during a very rainy Spring; office supplies, down to pencils and tablets, were doled out singly; every chemistry faculty office was also a laboratory, and at one time two offices, two faculty laboratories and a student laboratory were housed in one room. The brick and cement buildings had a very high heat capacity, resulting in morning summer temperatures of above 90° (high enough to

boil ether). In line with the do-it yourself plan, it might be noted that the first gas chromatograph in the department was built by George using a wooden box, a copper tube, and flashlight bulbs as thermal conductivity detectors. Vacuum lines and other glass apparatus usually were constructed by faculty members. Much "informal" plumbing also took place.

July of 1953 opened the academic year with three staff persons available, only one of whom was responsible solely to Chemistry. Kay Milne was the only secretary for all of Physical Sciences (Chemistry, Geology, Mathematics and Physics), Al Staats was machinist and all-around specialist for the division, and Frances Lewis was storeroom operator, bookkeeper, purchasing agent, laboratory manager and most indispensable person for Chemistry (according to Pierce). Ronald Tolberg, who had just finished his doctorate at Northwestern University under Jim Pitts, joined Conway Pierce and George Helmkamp in teaching the first chemistry classes in the Spring Semester of 1954. The first chemist graduating from UCR was Gene Garner in 1955. The chemistry majors who graduated through 1958 (first 4-year class at UCR) are shown below):

1955

Eugene Garner

1956

Charles Carlson
 Waldemar Klemm
 Albert Pugh
 Bruce Rickborn
 Thomas Ryan
 Brooke Thickston
 Donald Thompson
 John Peter Wolfe III

1957

Donald Bublitz
 Jack Opdyke
 Paul Paulsen

1958

Raymond George
 Franklin Goodspeed
 Harvey Lester
 Robert Lovins
 John Pernet
 Robert Rhodes
 Norman Schnautz
 Robert Woolfolk

A significant part of the requirements for graduation from this new Liberal Arts Campus was a Senior Thesis. In Chemistry this meant that all students got involved as soon as possible in undergraduate research. This student participation had dual importance. It provided the basis for the student's thesis but it also was highly significant in developing the research programs of the young faculty. Just how young the faculty seemed was illustrated by the fact that in 1954 a maintenance man refused to modify a laboratory for Johnson until he could find a "faculty member" to approve the desired change.

In Chemistry, Jim Pitts and Conway Pierce came in as established scientific investigators with outside grant support. The other faculty, newly out of graduate school as divisional policy, relied on quite modest University support and starter grants from sources such as Research Corporation to initiate research. Again, everything was a do-it-yourself kit. The faculty members were personally responsible for the teaching activities of lecturing, grading, teaching laboratory sections and even clean-up of laboratories; but they also had to rely for the most part on their own hands for the research-related experimental efforts. Things got so tight during the Summer of 1954 that Pomona College students were recruited into the research programs to keep things going.

James N. Pitts, Jr. was the first appointment made by Conway Pierce, although Jim did not come from his former post at Northwestern University as a full time associate professor here until July, 1954. Jim was reared in the LA area; and both his undergraduate and graduate work were completed at UCLA, the latter in physical chemistry/photochemistry. During WWII he worked on classified research projects on chemical and biological war-

fare for the National Defense Research Committee, where he met Conway Pierce. When he arrived at UCR he was one of fewer than 6 tenured faculty members in addition to the division chairs.

During the days of the Division of Physical Sciences there were 4 proto-departments (chemistry, geology, mathematics and physics); each of these unofficial units was headed by a proto-chair who dealt with Pierce in budgetary and administrative matters. Pitts served this function as long as there was a Division of Physical Sciences, and became the first official Chairman of the newly formed Department of Chemistry in 1959. He was influential in obtaining the addition of the original Physical Sciences Unit in 1960, in securing approval of the new chemistry building (Pierce Hall) occupied in 1966 and obtaining funding from the National Science Foundation and National Institutes of Health for expansion of the chemistry building north wing to its present size.

Jim is known for his indomitable enthusiasm and energy. He fought to free chemistry from budgeting policies that included counting the hot plates for next year and to focus on the larger picture of the department. He continually pressed for an adequate faculty both in numbers and in research capability. He was one of the leaders in conversion of UCR to a general campus that was in large part driven by the need for enhanced research visibility as well as the need to make time for research by making teaching loads more typical of the rest of the University. (Faculty frequently taught two courses and a full lab section each semester up to then.)

Jim may recall one Saturday morning in the early 1950's when Bob Wild (Physics) came from his laboratory nearly overcome with ammonia fumes from

an improperly operating liquid ammonia transfer system. He used the only gas mask available - a war surplus WWII standard issue army gas mask - to get to and turn off the valve. Also worth recalling were the "animated discussions" concerning administration of the machine and glassblowing shops (he established the first glass shop in the late 1950's) that occurred at budget splitting time.

In later years he became Director of the Statewide Air Pollution Research Center at UCR and by his vigorous administration rescued that organization from threatened closure.

His research has been in photochemistry, and he has maintained a well recognized program in that area as long as he has been at UCR. As part of that work he introduced the first postdoctoral fellows to the chemistry department, and one of his students was in the first class to receive Ph.D.'s from the chemistry department. Among others, his book with Jack Calvert, Photochemistry, is still a standard monograph.

Pitts has received the Tolman Award, the Chambers Award of the Air Pollution Control Association, the Clean Air Award of the California Heart & Lung Association, the Orange County ACS Section Award, and was recently elected a Fellow of the AAAS. In addition to his work at UCR, he was a consultant to the Santa Cruz campus initial development of the physical sciences.

In the Fall of 1954, Jim Pitts, who had wound up his responsibilities at Northwestern University, and Harry W. Johnson, Jr. joined Pierce, Helkamp and Tolberg to initiate the first full year of operation. This was the beginning of the era that characterized the nature of our student body, which, in turn, set the tone for con-

version of UCR from a small Liberal Arts campus to a General Campus.

The students originated as often from the junior colleges as from high schools. Their distribution among the college divisions was quite surprising (shocking, to many faculty), because an unexpectedly large fraction came in with science options for majors in a Liberal Arts program. The ultimate consequence, compelling though indirect, was to reinforce the idea that the campus with limited size and programs could not persist easily in the setting for which it was first visualized. Faculty members had to teach their own laboratory sections for undergraduate classes. With a rapidly expanding number of science majors in both the Physical and Biological sciences, four hours of laboratory supervision per section quickly exceeded any reasonable amount of time for which faculty members were available. Originally envisioned contact hours of 12 per semester rose to as high as 24, with one chemistry instructor averaging 17 over a three-year period. Something had to give way. If the faculty were expected to maintain the research quality and quantity expected within the University of California system, or if we were to maintain the quality of instruction for which we became well known, help had to be available. The obvious course, eventually implemented, was the generation of a graduate program with its available teaching assistants.

In the summer of 1955, Tolberg left as planned, and he was replaced by Hartland H. Schmidt. In response to the need for additional instructors Donald T. Sawyer joined the faculty in 1956 as the first full-time analytical chemist. Growth continued with the addition of James Hornig (physical) and John Garst (organic) in 1958 and with Ronald Archer (inorganic) and Manfred

Reinecke (organic) in 1959. Ted Kuwana joined the faculty in 1960 in analytical chemistry. The period of the late 1950's then, was a time of faculty as well as student growth. One of Sawyer's recollections is that of a student falling asleep during an analytical chemistry hour examination. It later developed that the student had been up all night protecting the family home (in Highland at the foot of the San Bernardino Mountains) from a forest fire.

Instrumentation was a major concern of the department in its early years even as it is now. The first major instrument was a Perkin-Elmer Model 21 Infrared Spectrophotometer purchased by Chemistry in cooperation with other departments, notably Entomology. Air conditioning was installed in part of the physical chemistry instrument room complex using a war surplus compressor mounted on the roof; since Regental policy did not allow air conditioning for human comfort, special permission was needed. An interesting sidelight arose when it was determined that the temperature compensating bimetallic strip on the prism mount had been installed backwards; after several phone calls a service man flew from Connecticut to replace the wayward part, and the instrument operated satisfactorily until it was replaced by a Model 221 in 1960. In 1957 the IR was joined by a Consolidated 21-620 mass spectrometer, and in 1958 both a Cary Model 14 Visible-UV Spectrophotometer and a Varian NMR were added. The latter was installed in a greenhouse, and at first it was operated largely at night when both the water supply temperature and the voltage were better regulated than in daytime hours. At times one could tune the NMR and then be unstable to catch a signal seen on an oscilloscope with the recorder. Funding for these purchases was a complicated mixture of chemistry funds, grant funds, funds from other departments, and special

dispensations from the UCR administration at times.

The first serious consequence of an exceptionally large number of students in the Physical Sciences was the problem of space - space for teaching laboratories, research laboratories, classrooms, service facilities and accommodation of specialized instruments. The need for the latter was perhaps the most difficult to justify according to the formulas then in existence. The only classroom available for more than about thirty students had no blackboards or facilities for experimental demonstrations, and the scheduling of laboratory classes began to impinge on evenings and weekends (again with demands on direct faculty supervision). The solution was the first campus justification for additional space, culminating the addition in 1960 of Unit 2 to Physical Sciences.

II. The Medieval Period - The Early 1960's

1959 and 1960 were watershed years for the protodepartment. The Department of Chemistry had been approved in 1959, with Pitts as the first chair. Also, with Pitts and Sawyer playing major roles, permission to establish graduate work in chemistry was obtained; Don Sawyer was the first graduate advisor. The original program for the Ph.D. included two foreign languages and written preliminary examinations. The oral examination included a research proposition unrelated to the student's research or dissertation. Space became momentarily less frustrating with the expansion to Physical Sciences Unit II (now the north wing of the Geology building); chemistry occupied the whole top floor of Physical Sciences I and II.

During the 1960's both undergraduate and graduate enrollment grew steadily to a high of about 6100 students in 1971. With the introduction of graduate work the faculty recognized the need to obtain established research competence and recognition; enrollment growth made it possible. In the normal course of events there was a substantial turnover of faculty by 1965. M.F. Hawthorne (1962) was the first tenured appointment made by the department after the initial staffing in its pursuit of excellence. In 1964, August Maki was appointed as an associate professor. Among those added in the early 1960's were Sunney Chan (1961), David Kearns (1962), and Jerry Bell (1962), Robert Neuman (1963), Phil Radlick (1963), Bill Orttung (1963) and Richard Wing (1965). Those leaving at various times were Hornig, Reinecke, Archer, and Garst. Temporary lecturers were used at times; notable among them was Jim Sims, now Professor of Plant Pathology. Warren Murdock and Walter Lehmann also served.

The graduate program in Chemistry grew from 17 students in 1960 to about 65 in the middle 1960's.

First Ph.D. Degrees Awarded

1963

Dr. James H. Sharp

1964

Dr. James K. Barr
Dr. Ronald D. Clark
Dr. Bruce W. Davis
Dr. Louis R. Kray
Dr. Richard J. Kula
Dr. David J. Pettit
Dr. Eddie T. Seo
Dr. James H. Sharp
Dr. Robert D. Stephens
Dr. James E. Tackett

The eventual high was reached with 72 in 1968. Space once again became a major problem. Graduate students were working all faculty laboratories, the physical chemistry lab, and a large number were crowded into a room designed as the quantitative analysis laboratory as well as in hallways in the basement. Undergraduate instructional demands also continued to rise. Almost as soon as Unit II was occupied plans were made to justify a new chemistry building to campuswide comments of "those damned pushy chemists again". Jim Pitts finally completed the justification and found partial NSF/NIH-PHS funding for a new building whose construction began in late 1963. Also in 1963, Harry Johnson succeeded Jim Pitts as chair of the department; and he, together with George Helmkamp, oversaw the construction of the new building that was occupied in 1966. While the new building was under construction, modification of the Unit I and II building was necessary to support research, and an outside laboratory as well as a high pressure room were added for hazardous reactions. The need for these facilities was demonstrated by a fire from a carborane preparation in the summer of 1964, that resulted in the need to completely rebuild one faculty laboratory room. Although cast iron pipes sagged from the heat and one Beckman DU spectrophotometer melted to an unrecognizable form, only one room was damaged seriously.

UCR is a beautiful campus. In large part the beauty is due to the supervising architect George V. Russell. However, he did not appreciate totally the needs of an active chemistry department, and Helmkamp had his hands full in obtaining a loading area and storage facility for the new building in the middle of the campus. That battle cost the department many hard earned brownie points with the administration.

In the early 1960's, instrumentation continued to be an important item for the department. A photoelectric spectropolarimeter was added in 1962, a Varian A-60 NMR spectrometer in 1963, a Cary 15 UV-visible spectrophotometer in 1964, and an X-ray diffraction unit in 1965 to make possible research for R.M. Wing.

In the early to middle 1960's additional non-academic staff were required to support the department's activities. Frances Lewis left the stockroom to become bookkeeper/ordering liaison/handywoman administrator; Imre Szabo, a Hungarian refugee with a degree in wine chemistry, replaced her in the stockroom. Mrs. Olive Peters became the department's first full time secretary and supervised the growth of the secretarial staff until her retirement. Warren Estes and Ralph Hill served as instrument technicians to keep spectrophotometric instruments working and to instruct students in their use. Tom Matthews left physical sciences to go to Entomology as glassblower, and Joe Bock became the first glassblower employed solely by chemistry. The divisional machine shop was broken up with completion of the Physics building, and Al Staats went to Physics. Hedley Whitlock became the first Chemistry machinist. The first electronics technician was John Taylor. Bill Gensel began work in the storeroom, eventually becoming the first formal general supervisor of non-academic personnel. Bill left in 1966 to pursue his interests, i.e., theater.

Also in 1964 Jim Pitts was the second Chemistry faculty member to be selected by the Academic Senate as Faculty Research Lecturer. Conway Pierce had given the lecture in 1959.

One of the sets of memories that remain from the early 1960's concerns the importance of off-

campus facilities in the development of research, for example the La Paloma restaurant where the proprietor participated in naming boron compounds (olide ions) in addition to the Bull and Mouth and Frank's Tavern where post-seminar discussions were commonly held, and the cocktail parties at faculty homes where departmental decisions were frequently reached informally.

The Baroque era of the department began with the accession of Don Sawyer to the chairmanship in 1966 with a new building to equip, a full-blown graduate program in place, a substantial non-academic staff to help the faculty, and a period of growth ahead. Optimism was the order of the day.

III. The Baroque Era 1966-1970

The 1966 academic year also ushered in the Quarter system at UCR. To some of us this was good, to others, not so good. In that year the faculty of the department included the full professors Hawthorne, Pitts, Helmkamp, and Sawyer; the Associate Professors Johnson, Maki, Schmidt, and Kearns, and the Assistant Professors Bell, Neuman, Orttung, Radlick, Boorstein, Gibian, and Wing. During The ensuing 3½ years of Don Sawyer's Chairmanship, the department greeted the arrival of Ted McKinney, Bill Okamura, Mike Rettig, Paul Ellgen, Bob (L. Robbin) Martin, Walter Deal, and Jim Sudmeier. Professor Roy Fukuto (Entomology) also joined us as a joint appointment. We also bid adieu to Fred Hawthorne (UCLA), Jerry Bell (Simmons College), and Seth Boorstein (Harvey Mudd College and, later, an optometrist in Newton, Mass.). This was clearly a time of expansion in faculty and facilities.

In 1967 the department also reached a pinnacle which will probably never be repeated. During that year there were ten Assistant Professors on the department's roster (and eight tenured Professors). Some of us remember the surreptitious "Assistant Professor Meetings" (one was at the Holiday Inn) and talk of APP (Assistant Professor Power). The next year the tenured faculty broke the back of the movement by successfully promoting two of the more obstreperous members of the group to tenure. (Sweet punishment).

The introduction of the Quarter system meant that all of the courses had to be re-examined and repropose. This was not difficult for one year courses like Chemistry 1, Organic and Physical Chemistry, but the one semester courses like Physical Chemistry Laboratory, Chemistry 5, and Instrumental Analysis were a different story.

Whether the physical chemists won or lost by getting a two-quarter physical chemistry lab is still debatable, since they had to teach it. And the Quarter system also spelled the end to Chemistry 185 ("Qual. O") which, although resurrected as "Structural Methods" (Chemistry 166), was never considered the same again by a few purists (some would say sadists). The chemistry curriculum pages from the 1956-66 and 1966-67 catalogs are reproduced in Appendix I. It's clear from comparing these pages that chemistry embarked on a new era in the Fall of 1966, and it is striking how little has changed over the last 19 years.

When Bill Gensel left for graduate studies and a new career, the department searched for and hired a new IBO (Laboratory Business Officer) (soon to be renamed MSO (Management Services Officer)). Duncan P. "Duke" Daries came to us from the Office of the Vice-Chancellor for Business and Finance and, before that, from a series of command and combat positions in the Air Force. Colonel Daries held an inspection and then proceeded to shape us up. While his standards were high, the most striking aspect of his staff leadership role in the department was his willingness to roll up his sleeves and clean out the coffee pot, or whatever. Duke led by example and was willing to do anything he asked of others.

One thing that both Don Sawyer and Duke Daries spent a lot of time doing was trying to acquire funds to keep our new and expensive building instruments, and faculty in operation. Fortunately, times were reasonably good and our contacts were also good. We grew and prospered. We were at the cutting edge of NMR even in those days and hosted a Varian NMR workshop in 1966 and a several-day advanced NMR symposium during the same period. The cutting edge meant two Varian

A-60's (one a new A-60A), our old DP-60, and our pride and joy HA-100 with multinuclear capability.

At the end of the 1969 calendar year, Don Sawyer left the Chairmanship, went on sabbatical for six months and, on his return in July, 1970, assumed the new position of Dean of Physical Sciences in the new College of Physical Sciences. George Helmkamp became Chairman in January, 1970, but, because he was finishing up a stint as an Associate Dean in the now-closing-months of the College of Letters and Science, Bob Neuman served as Vice-Chairman and Acting Chairman of Chemistry from January through June, 1970.

IV. The Era of Limits (or The Great Famine)

In July, 1970, the College of Letters and Science was no more, and we looked forward to our new home in the Physical Sciences College. George Helmkamp was immediately faced with the formidable task of trying to replace Duke Daries, who joined Don Sawyer in the new College office. Harvey Miller was interviewed and joined us and remained with the department until 1982, to set a record as the Chemistry MSO with the longest tenure of service. While the pre-1970's era was characterized by growth and expansion, the post-1970 era was one of limits. Budgets did not seem as good and George and Harvey were faced with frequent difficult decisions involving equipment, space and staffing problems. Harvey's mean golf game and some well-spent time on the links with key administrators always seemed to bear some fruit for us, however.

To indicate the different situation that we faced during the early 1970's, no new ladder faculty were added during George Helmkamp's four-year tenure as Chairman. He was successful, however, in augmenting our diversity with the appointment of Adjunct Assistant Professor Tom Cairns (chemist with the L.A. County Museum of Art and, later, with the FDA) and Jim Sims, then an Associate Professor from the Plant Pathology Department, as a joint appointment. Jim provided us with an expertise in natural products chemistry. During this same period, Lou DeHayes came on board as a lecturer (he became an Assistant Professor in 1975).

An event particularly noteworthy to graduate students, who received the news with some ecstasy, is described in the 1972-73 UCR catalog under "Chemistry" as follows: "....(c) Foreign Languages. A reading knowledge of German, French,

or Russian is recommended but not required for the doctor's degree in chemistry." Some of us were convinced that a UCR Chemistry Ph.D. would never be the same.

Some of us also worried that UCR would never be the same. During the 1972-73 academic year the campus, beset by a large enrollment decline, was faced with the prospect of the loss of a large number of faculty positions. A major topic of discussion on campus during 1973-74 was about where these positions would come from. Each department was being asked to justify its position and its positions. Although it was not known at this time, these resource problems had already sealed the fate of our new disciplinary colleges. In one more year the College of Physical Sciences would become history.

It was on this kind of note that the Chairman's "master" was transferred from a grateful George Helmkamp to Hart Schmidt in July, 1974. The Era of Limits (or as one of us called it--The Blue and Gold) era gave way to the Contemporary Era in the department's history.

V. The Contemporary Era

Addition of ladder faculty assumed a high priority during Hart Schmidt's tenure as Chair. During 1975-76, four assistant professors were appointed (DeHayes, Midland, Birge, and Scott). Mark Midland (who received a Sloan Fellowship in 1978) and Gary Scott remain on the faculty. Lou DeHayes is now a Director/Research at California Portland Cement in Colton and Bob Birge has just begun a new career as the Head of the Chemistry Department at Carnegie-Mellon University, Pittsburgh, PA.

On July 1, 1975, the College of Physical Science was merged with the College of Biology and Agriculture to form the College of Natural and Agricultural Science under Dean Mack Dugger. The merger was a recognition of the need to conserve campus resources in the era of extreme constraint. Don Sawyer will remember one afternoon following a period of tension with the Chancellor when virtually all of the faculty of the College of Physical Sciences signed a petition in his support; it even helped resolve the crisis in Don's favor. In 1975, Phil Radlick resigned and became a Vice President for Research at Merck and Co., Rahway, N.J., David Kearns left UCR to join the Chemistry faculty at UC San Diego and August Maki left to join the UC Davis campus.

During the 1974-1977 period, considerable upgrading of the undergraduate organic teaching labs (third floor east wing) was accomplished. Two labs which were originally occupied by Fred Hawthorne's group were "stripped" and were converted to a more workable teaching configuration. In addition, the two labs across that hall were upgraded as teaching labs. These four labs now serve 300-400 organic students each year.

In 1974-1975, the Department (with Jim Sudmeier's leadership) jumped headlong into serious multinuclear Fourier Transform NMR, by means of the Department's second successful equipment grant from NSF (the first supported purchase of an HP3000 computer system, and the third led to installation of the Spex Laser Raman facility in 1977). The "Bruker 90" wide-bore system arrived with what seemed to be the maximum number of mechanical start-up problems and with a great deal of promise (we can look at any nucleus! - well almost). By this time Bob Neuman was acting chair for a year (1976-77) while Hart Schmidt was on sabbatical at the National Bureau of Standards, and Bob recalls having to deal with the manifold mechanical and personal problems that came in the door with the Bruker 90.

In addition to the Bruker installation during the Neuman acting chairman-ship, the Department was awarded funds for more conventional NMR facilities under a new University "obsolete instructional equipment" program. This award resulted in the replacement of the Varian A-60's with Varian EM360 and EM390 permanent magnet proton instruments. Thus for a short time, UCR was again truly "state-of-the-art" in low field NMR capability.

The year 1976 was also the year that serious planning for repainting Pierce Hall commenced. Acting Chair Neuman recalls presenting samples of paint at a Wednesday seminar in order to get input from those who would have to live with the choices. As a result, "Battleship Gray" Pierce Hall has now been converted to yellows, beiges, muted oranges, and in one case (guess which faculty office) to what could only be described as "outrageously orange." For the second time, the Department offered "Perspectives in Industrial Chemistry" in 1976-1977. This quarter-long graduate course exposed the graduate students to a

series of varied industrial chemists, who presented their views on diverse topics from hard-core chemistry to career development. This course, along with its first version (1973-4) and its third (1983-4), was a big plus for both graduate students and faculty.

During 1978-79, Don Sawyer was voted Faculty Research Lecturer and thus became Chemistry's fourth faculty member to receive this honor (including Jim Pitts, Conway Pierce and David Kearns). In that same year Don was also honored by being named a Fellow of the American Association for the Advancement of Science.

In 1979-80, with Bob Neuman now the Department Chair succeeding Hart Schmidt, a number of memorable events occurred. The completion of the painting of Pierce Hall occurred after what seemed like years of effort. A major step forward in photocopying/reproduction services occurred when the Department allowed what was the Receptionist's Office to be taken over by the Campus to be converted to a "Fast Copy" center for Chemistry and other nearby departments. In the area of equipment acquisition, the Department replaced aging Cary 14 spectrophotometers with a Cary 17 and a Cary 219, both of which are currently being eyed for replacement themselves. In addition, the old Varian ESR instrument was upgraded by the purchase of an IBM console/waveguide. Mort Gibian left the faculty that year to become Chair at Seton Hall University, South Orange, N.J., and Paul Haake from Wesleyan University visited our Department and taught for one quarter.

The ongoing search for an Assistant Professor in Physical Chemistry was concluded with the hire of David Bocian in 1979. David received a Sloan fellowship in 1982 and was promoted to Associate Professor in July, 1984.

One of the more far-reaching actions of Bob Neuman's year as Chair was the decision reached by the faculty to seek upper administration support for addition of one additional faculty member in analytical chemistry. This decision was taken in recognition of the fact that our Ph.D. program in analytical chemistry was (and is) the only such formal program in the state. It was argued (successfully) that additions of faculty to the program would very likely have significant impact on its attractiveness to graduate students. The administration approved the plan to hire one analytical faculty member (any level, including Full Professor) and in the Fall of 1979, the search was begun. Not long after this Don Sawyer announced his intention to resign and accept the position of Provost at Lehigh University!

Early in 1980, Mike Rettig assumed the Department Chair's position. Virtually his first act as Chair was to announce the re-acquisition of Don Sawyer (things weren't working out with the Lehigh negotiations). Later actions in the analytical area led to the appointments at Full Professor of Charles Wilkins (1981 from the University of Nebraska) and Peter Griffiths (1982 from Ohio University). These individuals brought new expertise in the areas of Fourier Transform Mass Spectrometry and Fourier Transform Infrared to the Department. The third faculty addition during this period was Tom Morton, who came to UCR from Brandeis University. Tom Morton is a physical organic chemist with interests in gas phase ion chemistry and the chemistry of the sense of smell.

Charter faculty member George Helmkamp retired in 1981, after 28 years service to the department and the Campus. George, who is now Professor Emeritus, is still active in teaching, and has even agreed to teach part of Chemistry 1 this

year. The next year saw the retirement of our management services officer, Harvey Miller, whom George had hired when he became Chair in 1970. Harvey now is quite happy spending as much time as possible on the golf course.

Since Mike Rettig's time as Chair left the inorganic discipline a bit thin, a number of inorganic visiting faculty were in residence during this period. Included in the group were Brian Mann (University of Sheffield), Michael Green (University of York), and Allen Hill (Oxford University). Also on campus for a series of lectures was R.J.P. Williams (also from Oxford). Three faculty (Birge, Midland, Scott) were promoted to tenured positions in 1981, and Harry Johnson became Associate Graduate Dean in the same year (Harry had been the Graduate Dean from 1974-1980).

The period 1980-1982 had considerable faculty involvement in writing two NSF equipment grants. Those grants were successful, and led to the installation of a Nicolet 300 Multinuclear NMR (with satellite Nicolet data station interfaced to the "old" Bruker 90 magnet), and a Nicolet FTMS 1000 Fourier Transform Mass Spectrometer. Additional equipment installed in those years included a JEOL FX200 $^1\text{H}/^{13}\text{C}$ NMR and an Enraf-Nonius Single Crystal X-Ray Diffractometer (to replace the Picker FACS1). History will record that the Department also bought a microwave oven during this period!

VI. The Era of Renewed Optimism

In late 1982, Charles Wilkins was named department Chair. This happened at the time Harvey Miller was retiring, so Charles was able to be an important participant in the hiring of a key aide to the Chair, namely management services officer Linda McCafferty (affectionately known as Little Mac, with Wilkins dubbed Big Mac).

In 1983, a second departmental mass spectrometer was installed (VG ZAB, purchased partly on competitive NIH equipment funds), and a Ph.D. staff spectroscopist was hired. An important early priority of Wilkins' chairmanship was acquisition of staff salary funds adequate to support the newly acquired major instrumentation (two mass spectrometers, a third now "on order," two high field NMR instruments). These salaries were "nailed down" and the department now has two NMR staff spectroscopists (Robert Lee, Christine Tseng) and two staff mass spectroscopists (Richard Kondrat, Russ Tsao). Additional major equipment recently acquired include a Spex spectrofluorimeter and two Nicolet FT-IR instruments.

Two faculty resignations this year (Sudmeier to private consulting/entrepreneurship, Birge to Carnegie-Mellon) have created two openings on the faculty and nationwide searches were undertaken to fill those positions. We expect Dallas Rabenstein (Alberta) to join us July 1, 1985, as Professor of Analytical Chemistry.

The UCR chemistry faculty continue to be externally recognized for their work. Professor Sawyer won the Tolman Award in 1983, given by the Southern California Section of the A.C.S. In addition, Charlie Wilkins received the 1982 Lester Strock Award of the Society for Applied Spectroscopy, and Peter Griffiths will receive the

1985 Pittsburgh Spectroscopy Award from the Spectroscopy Society of Pittsburgh. Awards to Jim Pitts during this period (Chambers, Tolman, Fellow AAAS) were noted earlier.

It is appropriate to conclude this narrative with a tribute to the Chemistry staff of the past and present - too numerous to mention individually - who have in so many important ways contributed to the productivity of the faculty and students in the Department. The faculty and students fully recognize staff efforts in maintaining the smooth operations of the Department in its teaching and research roles. Working together the faculty and staff of the Department have have participated in the award of 432 B.A./B.S. degrees, 111 Masters' degrees, and 175 Ph.D. degrees in Chemistry since the campus opened in 1954. At the present time in Chemistry at UCR 45 undergraduate majors and 57 graduate students are pursuing degree objectives.

Appendix I

Catalogue copy comparing Chemistry Department courses before and after adoption of the quarter system.

Lower Division Courses

Physical Sciences 1A-1B. Introduction to the Physical Sciences. (4-4)

An introduction to physics, chemistry, and geology. Selected topics of current and historical interest including classical mechanics, the earth's structure, electricity and magnetism, waves, spectroscopy, atomic energy levels, the periodic table, chemical bonds, radioactivity, geological time scales, nuclear physics, elementary particles. Mr. Wild.

1A-1B-1C. General Chemistry. (4-4-4)

Prerequisite: Two years of high school algebra. High school chemistry is recommended, otherwise consent of instructor is required. An introduction to the principles of chemistry. Either Chemistry 1A-1B-1C or Chemistry 4A-4B-4C is prerequisite to all other chemistry courses. The Staff.

4A-4B-4C. General Chemistry. (5-5-5)

Prerequisite: high school chemistry, concurrent registration in Mathematics 9A. An intensive course designed to challenge the student and accelerate the program of the well prepared student. Equivalent in content to Chemistry 1A-1B-1C and Chemistry 5. This course is designed to give a solid introduction to the quantitative and structural aspects of chemistry. The Staff.

5. Quantitative Analysis. First Course. (5)

Prerequisite: Chemistry 1C with a grade of C or better. Introductory principles and practices of quantitative analysis. Stoichiometric calculations and application of principles of chemical equilibrium to analytical problems; laboratory, titrimetric and gravimetric analysis. The Staff.

8A-8B. Organic Chemistry. (4-4)

Prerequisite: Chemistry 1C or 4C. An introduction to the chemistry of aliphatic and aromatic compounds; elementary reactions of functional groups; laboratory techniques in synthesis and identification. A short terminal course designed to satisfy certain life science and preprofessional programs. The Staff.

Upper Division Courses

The 180 series courses in chemistry are primarily for beginning graduate students and outstanding seniors.

109A-109B. Physical Chemistry. (3-3)

Prerequisite: knowledge of differential calculus (Mathematics 9A-9B). Material to be covered will include thermodynamics, kinetics, non-electrolyte and electrolyte solution theory, changes of phase and related subjects. Designed primarily for students with major interests in life and agricultural sciences. Does not fulfill major requirements for chemistry department majors. The Staff.

110A-110B-110C. Physical Chemistry. First Course. (3-3-3)

Prerequisite: Chemistry 1A-1B-1C or 5 with a grade of C or better; Physics 4A-4B-4C-4D; Mathematics 9D (may be taken concurrently). Nonchemistry majors may be admitted without course 5 with consent of instructor. The first, second, and third laws of thermodynamics and their application to a variety of problems of chemical interest including chemical equilibria, thermochemistry, solid, liquid and gaseous states of matter, phase equilibria, properties of solutions (non-ionic and ionic); theory of ionic solutions, ionic conduction, electrolytic processes. Kinetic molecular theory and introduction to statistical mechanics; chemical kinetics and its relation to statistical mechanics and kinetic molecular theory; introduction to quantum theory and its application to properties of atoms and the structure of molecules. The Staff.

111A. Physical Chemistry Laboratory. (3)

Prerequisite: Chemistry 110A; prerequisite or concurrent, Chemistry 110B. Physical-chemical measurements and laboratory experiments illustrating fundamental principles of physical chemistry. The Staff.

111B. Physical Chemistry Laboratory. (3)

Prerequisite: 110A-110B; prerequisite or concurrent, 110C. Physical-chemical measurements and laboratory experiments illustrating fundamental principles of physical chemistry. The Staff.

112A-112B-112C. Organic Chemistry. (4-4-5)

Prerequisite: Chemistry 1C or 4C with a grade of C or better, or Chemistry 8A-8B. Chemistry of aliphatic and aromatic compounds using theory of structure and reaction mechanisms as a basis for discussion. The order of topics will be aliphatic chemistry, aromatic chemistry, and natural products. Laboratory: organic synthesis, qualitative analysis, physical techniques. The Staff.

125. Instrumental Methods. (5)

Prerequisite: Chemistry 4A-4B-4C or 5, Physics 4A-4B-4C or equivalent; or consent of instructor. An extensive treatment of chemical equilibria, separations, electrochemistry, and the principles of optical methods. These topics are discussed and presented as an introduction to instrumental methods. The theories and applications of important instrumental methods are treated in the lectures and in the laboratory. The Staff.

139. Organic Synthesis. (2)

Prerequisite: Chemistry 183 (may be taken concurrently). Advanced laboratory techniques in the synthesis of organic compounds. The Staff.

150A-150B. Inorganic Chemistry. (3-3)

Prerequisite: Chemistry 110A. An introduction to modern inorganic chemistry, with special emphasis on structure and bonding of important classes of inorganic compounds. The synthesis and reactions of many important compounds of the elements are discussed systematically. The Staff.

166. Structural Methods. (5)

Prerequisite: Chemistry 112C and 125 with a grade of C or better and 150A (may be concurrent). Methods for the identification and elucidation of structures of inorganic and organic compounds using modern techniques. Instrumental methods, particularly spectroscopy, will be emphasized. The Staff.

181A-181B-181C. Advanced Physical Chemistry. (3-3-3)

Prerequisite: Chemistry 110C with a grade of C or better. Selected topics in modern physical chemistry, including elementary wave mechanics, atomic structure and spectra, nature of the chemical bond, molecular structure and spectra, intermolecular forces, elementary statistical mechanics, the states of matter, and photochemistry. The Staff.

183. Intermediate Organic Chemistry. (3)

Prerequisite: Chemistry 112C, or equivalent, with a grade of C or better. The chemistry of organic compounds, including some special topics presented at a more advanced level than in an introductory course. The Staff.

184A-184B. Introduction to Physical Organic Chemistry. (3-3)

Prerequisite: Chemistry 112C, 110C. Introduction to the physical aspects of organic chemistry. The Staff.

190. Special Studies. (1-5)

To be taken with the consent of the chairman of the department as a means of meeting special curricular problems. The Staff.

195. Senior Thesis. (1-4)

Prerequisite: senior status; German 2 or a reading knowledge of German. Recommended for honors students. Each student will submit a thesis based upon an independent survey of the literature of some special topic. Total credit may not exceed six units. The Staff.

199. Senior Research. (1-4)

Prerequisite: senior status, consent of instructor. An introduction to the laboratory methods of research in the fields of analytical, organic, inorganic, or physical chemistry. The student will conduct a carefully supervised investigation in one of the aforementioned fields and will submit a written report on his work. The Staff.

199H. Senior Honors Research. (1-6)

Prerequisite: senior status, an average of grade B or higher in chemistry courses, consent of instructor. Original research in the fields of analytical, inorganic, organic, or physical chemistry. The student will be required to submit a written report of his work. Total credit for 199 and/or 199H may not exceed 9 units. The Staff.

Graduate Courses**203A-203B. Chemical Thermodynamics. (2-2)**

Prerequisite: consent of instructor. The thermodynamics of systems of chemical interest. The Staff.

204A-204B. Chemical Kinetics. (2-2)

Prerequisite: consent of instructor. A critical consideration of the kinetics of all important classes of chemical reactions. Experimental methods and application of theory. Recent advances in the theory of reaction rates. The Staff.

205. Chemical Quantum Mechanics. (3)

Prerequisite: consent of instructor. The elements of quantum mechanics with particular emphasis on chemical problems. The Staff.

206. Chemical Statistical Mechanics. (3)

Prerequisite: consent of instructor. The fundamentals of statistical mechanics and selected topics of current physical-chemical interest. The Staff.

209 (D-Z). Advanced Topics in Physical Chemistry. (2-3)

Prerequisite: consent of instructor. Selected advanced topics from modern physical chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter). The Staff.

219 (D-Z). Advanced Topics in Organic Chemistry. (2-3)

Prerequisite: consent of instructor. Selected advanced topics from modern organic chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter). The Staff.

229 (D-Z). Advanced Topics in Analytical Chemistry. (2-3)

Prerequisite: consent of instructor. Selected advanced topics from modern analytical chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter). The Staff.

239 (D-Z). Advanced Topics in Inorganic Chemistry. (2-3)

Prerequisite: consent of instructor. Selected advanced topics from modern inorganic chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter). The Staff.

250. Graduate Seminar in Chemistry. (1)

Prerequisite: graduate student status. Oral reports by graduate students, faculty, and visiting scholars on current research topics in chemistry. The course will be graded Satisfactory (S) or Unsatisfactory (U). The Staff.

251. Graduate Seminar in Analytical Chemistry. (2)

Prerequisite: graduate student status. Oral reports and discussion by students, faculty, and visiting scholars on current research topics in analytical chemistry. The Staff.

252. Graduate Seminar in Inorganic Chemistry. (2)

Prerequisite: graduate student status. Oral reports and discussion by students, faculty, and visiting scholars on current research topics in inorganic chemistry. The Staff.

253. Graduate Seminar in Organic Chemistry. (2)

Prerequisite: graduate student status. Oral reports and discussion by students, faculty, and visiting scholars on current research topics in organic chemistry. The Staff.

254. Graduate Seminar in Physical Chemistry. (2)

Prerequisite: graduate student status. Oral reports and discussion by students, faculty, and visiting scholars on current research topics in physical chemistry. The Staff.

297. Directed Research. (1-6)

Prerequisite: consent of a staff member. Research in analytical, inorganic, organic, or physical chemistry under the direction of a member of the staff. A written report is required of the student at the end of the research study. The Staff.

299. Research for Thesis or Dissertation. (1-12)

Prerequisite: consent of a staff member. Research in analytical, inorganic, organic, or physical chemistry under the direction of a member of the staff. This research is to be included as a part of the dissertation. The Staff.

CLASSICS

Douglass S. Parker, Ph.D., *Associate Professor of Classical Civilization (Chairman of the Department)*

†Anastasius C. Bandy, Ph.D., *Assistant Professor of Classics*



Thomas D. Burney, M.A., *Acting Assistant Professor of Classics*

John C. Hall, M.A., *Lecturer in Classics*

The Department of Classics offers work in the Greek and the Latin languages and literatures and in Greek and Roman history. It is interested not only in those students who major in the field of Greek and Latin classics, but also in those who would like to relate classics to other fields as well as those who plan a teaching career on the high school, college, or university level. It is the intent of

† On leave, 1966-1967

Courses of Instruction

Graduate Program in Chemistry

Orientation Examinations

All students admitted to regular graduate status as prospective candidates for master's or doctor's degrees in chemistry are required, at the beginning of their first semester in residence, to take orientation examinations. The examinations are normally given on the Thursday and the Friday immediately preceding registration week. Although a notice of the times and places of these examinations is usually sent to each student admitted to regular graduate status in chemistry, it is the student's responsibility to be on the campus early enough to check the bulletin boards in the Chemistry Building for this information. Students working toward advanced degrees in chemistry take these examinations in the four fields of analytical, inorganic, organic, and physical chemistry. The sole purpose of this requirement is to permit the staff to recommend the course of work that will most effectively aid the student's development in his chosen field. Fields of specialization now offered by the Department of Chemistry are analytical chemistry, inorganic chemistry, organic chemistry, and physical chemistry.

Requirements for the Master's Degree

Requirements are:

1. Orientation examinations in analytical, inorganic, organic, and physical chemistry.
2. General University requirements. See the *Announcement of the Graduate Division, Riverside*.
3. Departmental requirements:

Plan I

- a. Demonstration of a reading knowledge of German, French, or Russian.
- b. Twenty units of approved courses and graduate research, of which at least 8 must be in the 200 series and 6-8 in graduate research.
- c. A thesis.
- d. A final oral examination on the thesis may be required.

Plan II

- a. Demonstration of a reading knowledge of German, French, or Russian.
- b. At least 24 units of upper division and graduate courses of which at least 12 must be in the 200 series courses in chemistry. Course credit in areas closely related to the field of concentration (such as physics and mathematics) may, on the approval of the Graduate Adviser, be applied toward the satisfaction of the total unit requirement.
- c. Passing comprehensive final examinations covering all four fields of chemistry required.

Requirements for the Doctor's Degree

The requirements are:

1. Orientation examinations in analytical, inorganic, organic, and physical chemistry.
2. General University requirements. See the *Announcement of the Graduate Division, Riverside*.
3. Departmental requirements:
 - a. *Program of Study*. A program of study will be recommended by the departmental committee on Graduate Study on the basis of the student's performance in the orientation examinations and a consideration of his field of specialization.

b. *The Cumulative (Major Field) Examination*. To encourage a planned program of study and literature reading carried out concurrently with research and to provide for a more continuous monitoring of the student's intellectual growth and development, the major examination in each field of specialization offered for the doctor's degree (namely, analytical, inorganic, organic, and physical chemistry) shall consist of "cumulative" one-hour examinations, one given each month for the eight months of October, November, December, January, February, March, April, and May of each academic year, with the possible addition of an examination in June or July. The student is allowed to start taking these examinations with the first one scheduled during his first semester of residence if he is on regular graduate status and has no deficiencies (as indicated by the orientation examinations) in his probable major field of study. Thereafter the examinations are taken continuously until five are passed except that the student may omit the summer examination and one additional examination each year on any occasion.

c. *Foreign Languages*. A reading knowledge of German and of either French or Russian is required of all candidates for the doctor's degree in chemistry.

d. *Oral Qualifying Examination*. After passing the foreign language examinations and the required number of cumulative examinations, the candidate is given an oral examination by his doctoral committee. This examination consists in part of defending an original proposition and is designed to test the extent of the candidate's development and his breadth of knowledge in chemistry and related fields.

Lower Division Courses

1A-1B. General Chemistry. (4-4) Yr. Mr. Pitts
Lecture, three hours; discussion, one hour; laboratory, one three-hour period.

Prerequisite: two years of high school algebra. High school chemistry is recommended.

An introduction to the principles of chemistry. Either Chemistry 1A-1B or Chemistry 4A-4B is prerequisite to all other chemistry courses. Chemistry 2A-2B may be substituted as prerequisite to Chemistry 8 and 9.

*2A-2B. General Chemistry. (4-4) Yr. The Staff
Lecture, three hours; laboratory, one three-hour period.

Prerequisite: none.

An introductory course emphasizing the principles of chemistry, including a brief introduction to elementary organic chemistry.

4A-4B. General Chemistry. (5-5) Yr. Mr. Bell
Lecture, three hours; laboratory, two three-hour periods.
Prerequisite: high school chemistry, concurrent registration in Mathematics 9A and Physics 4A.

Intensive course designed to challenge the student and accelerate the program of the well prepared student. Equivalent in content to Chemistry 1A-1B and Chemistry 2B. This course is designed to give a solid introduction to the quantitative and structural aspects of chemistry.

8. Organic Chemistry. (3) I. Mr. Radlick
Lecture, three hours.

Prerequisite: Chemistry 1B, 2B, or 4A-4B.

An introduction to the chemistry of aliphatic and aromatic compounds; elementary reactions of functional groups. A terminal course designed to satisfy a one-semester requirement in organic chemistry.

* Not to be given, 1965-1966.

- 9. Organic Chemistry Laboratory. (2) I.** Mr. Radlick
Lecture, one hour; laboratory, one three-hour period.
Prerequisite: Chemistry 8 (may be taken concurrently).
A course in the laboratory techniques of organic chemistry designed to accompany Chemistry 8.
- 23. Quantitative Analysis, First Course. (4) I and II.** Mr. Kuwana
Lecture, two hours; laboratory, two three-hour periods.
Prerequisite: Chemistry 1B with a grade of C or better.
Introductory principles and practices of quantitative analysis. Stoichiometric calculations and applications of principles of chemical equilibrium to analytical problems; laboratory, titrimetric and gravimetric analyses.

Upper Division Courses

The 180 series courses in chemistry are primarily for beginning graduate students and outstanding seniors.

- *109. Physical Chemistry. (3) I.** Mr. Pitts
Prerequisite: knowledge of differential calculus (Mathematics 9A-9B).
Material to be covered will include thermodynamics, kinetics, non-electrolyte and electrolyte solution theory, changes of phase and related subjects. Designed primarily for students with major interests in life and agricultural sciences. Does not fulfill major requirements for chemistry department majors.
- 125. Instrumental Analysis. (4) I.** Mr. Sawyer
Lecture, two hours; laboratory, two three-hour periods.
Prerequisite: Chemistry 4A-4B or 23, Physics 2A-2B or equivalent.
A more extensive treatment of the theories of acidimetry, alkalimetry, oxidimetry, and electrochemistry. These topics are discussed and presented as an introduction to instrumental techniques. The theories and applications of important instrumental methods in chemical analysis are treated in the lectures and the laboratory of the latter part of the course.
- 135A-135B. Organic Chemistry. (4-4) Yr.** Mr. Hawthorne
Lecture, three hours; laboratory, one three-hour period.
Prerequisite: Chemistry 1B or 4B with a grade of C or better, or Chemistry 8.
The chemistry of aliphatic compounds, fundamental theories of organic chemistry, and an introduction to reaction mechanisms during the first semester. Chemistry of aromatic compounds and natural products during the second semester.
Laboratory: organic synthesis, qualitative analysis, physical techniques.
- *139. Organic Synthesis. (2) II.**
Laboratory, two three-hour periods.
Prerequisite: Chemistry 183 (may be taken concurrently).
Advanced laboratory techniques in the synthesis of organic compounds.
- 140A. Physical Chemistry. First Course. (3) I.** Mr. Ortung
Lecture, three hours.
Prerequisite: Chemistry 4A-4B or 23 with a grade of C or better; Physics 4A-4B-4C; Mathematics 9C (may be taken concurrently).
Nonchemistry majors may be admitted without course 23 with the consent of the instructor.
The laws and theories of chemical phenomena and the application of these laws to definite problems in chemical thermodynamics, thermochemistry, gas laws, kinetic molecular theory, and the colligative properties of solutions.

- 140B. Physical Chemistry. Second Course. (3) II.** Mr. Kearns
Lecture, three hours.
Prerequisite: Chemistry 125 with a grade of C or better, Mathematics 9C.
Homogeneous and heterogeneous equilibria and the phase rule, ionic theory and electrical properties of solutions, electrochemistry, use of free energy and entropy concepts in calculations of equilibrium constants, chemical kinetics.
- 142. Physical Chemistry Laboratory. (4) II.** Mr. Bell
Lecture, two hours; laboratory, two three-hour periods.
Prerequisite: Chemistry 140A; concurrent, Chemistry 140B.
Physical-chemical measurements and laboratory experiments illustrating fundamental principles of physical chemistry.
- 150. Inorganic Chemistry. (3) II.** The Staff
Lecture, three hours.
Prerequisite: Chemistry 140A (may be taken concurrently).
An introduction to modern inorganic chemistry, with special emphasis on the periodic behavior of the elements. The structures and reactions of many important compounds of the elements are discussed systematically.
- 181A-181B. Advanced Physical Chemistry. (3-3) Yr.** Mr. Kearns
Lecture, three hours.
Prerequisite: Chemistry 140B with a grade of C or better.
Selected topics in modern physical chemistry, including elementary wave mechanics, atomic structure and spectra, nature of the chemical bond, molecular structure and spectra, intermolecular forces, elementary statistical mechanics, the states of matter, and photochemistry.
- 183. Intermediate Organic Chemistry. (3) I.** Mr. Helmkamp
Lecture, three hours.
Prerequisite: Chemistry 135B, or equivalent, with a grade of C or better.
The chemistry of organic compounds, including some special topics, presented at a more advanced level than in an introductory course.
- 184. Introduction to Physical Organic Chemistry. (3) II.** Mr. Neuman
Lecture, three hours.
Prerequisite: Chemistry 135B, 140B, or equivalent, with a grade of C or better; Chemistry 183, or consent of the instructor.
Introduction to the physical aspects of organic chemistry.
- 185. Qualitative Organic Analysis. (4) II.** Mr. Radlick
Lecture, two hours; laboratory, two three-hour periods.
Prerequisite: Chemistry 135B with a grade of C or better.
- 190. Special Studies. (1-4) I and II.** The Staff
To be taken with the consent of the chairman of the department as a means of meeting special curricular problems.
- 195. Senior Thesis. (2) I and II.** The Staff
Prerequisite: senior status; German 2 or a reading knowledge of German.
Recommended for honors students. Each student will submit a thesis based upon an independent survey of the literature of some special topic.
- 196A-196B. Senior Seminar. (1-1) Yr.** Mr. Johnson
The first half of the first semester will be devoted to a discussion of the use of the chemical literature. The remainder of the year will be used for seminars by students, staff members, and outside speakers.
- 197. Senior Research. (1-5) I and II.** The Staff
Prerequisite: senior status, consent of the instructor.
An introduction to the laboratory methods of research in the fields of analytical, inorganic, organic, or physical chemistry. The student will conduct a carefully supervised investigation in one of the aforementioned fields and will submit a written report of his work.

Courses of Instruction

199. Senior Honors Research. (1-5) I and II. The Staff
Prerequisite: senior status, an average of grade D or higher in chemistry courses, consent of the instructor.
Original research in the fields of analytical, inorganic, organic, or physical chemistry. The student will be required to submit a written report of his work. Total credit for 197 or 199 may not exceed 6 units.

Graduate Courses

203. Chemical Thermodynamics. (3) I. Mr. Schmidt
Prerequisite: consent of the instructor.
The thermodynamics of systems of chemical interest.

*204. Chemical Kinetics. (3) I. Mr. Pitts
Prerequisite: consent of the instructor.
A critical consideration of the kinetics of all important classes of chemical reactions. Experimental methods and application of theory. Recent advances in the theory of reaction rates.

*205. Chemical Quantum Mechanics. (3) I. Mr. Kearns
Prerequisite: consent of the instructor.
The elements of quantum mechanics with particular emphasis on chemical problems.

206. Chemical Statistical Mechanics. (3) II. The Staff
Prerequisite: consent of the instructor.
The derivation of the laws of molecular assemblies from the properties of the individual molecules and their mutual interaction.

209A-Z. Advanced Topics in Physical Chemistry. (2 or 3) I and II. The Staff
Prerequisite: consent of the instructor.
Selected advanced topics from modern physical chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter).

219A-Z. Advanced Topics in Organic Chemistry. (2 or 3) I and II. Mr. Neuman
Prerequisite: consent of the instructor.
Selected advanced topics from modern organic chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter).

229A-Z. Advanced Topics in Analytical Chemistry. (2 or 3) II. Mr. Sawyer
Prerequisite: consent of the instructor.
Selected advanced topics from modern analytical chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter).

239A-Z. Advanced Topics in Inorganic Chemistry. (2 or 3) I, II. The Staff
Prerequisite: consent of the instructor.
Selected advanced topics from modern inorganic chemistry. The contents of these courses will vary. Course may be repeated with different topic (and different letter).

250. Graduate Seminar in Chemistry. (1) I, II. Mr. Johnson
Prerequisite: graduate student status.
Oral reports by graduate students, faculty, and visiting scholars on current research topics in chemistry. The course will be graded Satisfactory (S) or Unsatisfactory (U).

* Not to be given, 1965-1966.

Chemistry

251. Graduate Seminar in Analytical Chemistry. (2) I, II. Mr. Kuwana
Prerequisite: graduate student status.
Oral reports and discussion by students, faculty, and visiting scholars on current research topics in analytical chemistry.

252. Graduate Seminar in Inorganic Chemistry. (2) I, II. Mr. Hawthorne
Prerequisite: graduate student status.
Oral reports and discussion by students, faculty, and visiting scholars on current research topics in inorganic chemistry.

253. Graduate Seminar in Organic Chemistry. (2) I, II. Mr. Johnson
Prerequisite: graduate student status.
Oral reports and discussion by students, faculty, and visiting scholars on current research topics in organic chemistry.

254. Graduate Seminar in Physical Chemistry. (1) I, II. The Staff
Prerequisite: graduate student status.
Oral reports and discussion by students, faculty, and visiting scholars on current research topics in physical chemistry.

297. Graduate Research in Chemistry for Individual Students. (1-6) I, II. The Staff
Prerequisite: consent of a staff member.
Research in analytical, inorganic, organic, or physical chemistry under the direction of a member of the staff. A written report is required of the student at the end of the research study.

299. Graduate Research in Chemistry for Dissertation. (1-6) I, II. The Staff
Prerequisite: consent of a staff member.
Research in analytical, inorganic, organic, or physical chemistry under the direction of a member of the staff. This research is to be included as a part of the dissertation.

Appendix II

Undergraduate Degree Recipients 1954-June, 1984

Note that there are two lists, so check both to find your name. We hope that no one was omitted accidentally.

Guenter Ahlers
Jeffrey Albert
Frank Anthony Alonge
Robert S. Altman
Robert T. Ambrose
David W. Antrosio
Sara M. Aschmann
Stephen J. Backlund
William W. Baird
Frances C. Baribeau
John S. Barkley
Deborah E. (Bastedo) Lerner
Patricia A. Bastiaans
Ann L. Bayerque
James P. Beck
Michael C. Beechan
Stuart J. Bell
Stuart L. Belli
Dennis E. Bender
Edwin L. Berger
Denny Beroiz
Donald M. Besemer
Patricia A. Blair
Vernon C. Bohr Jr.
Richard A. Borders
Douglas A. Bostrom
Ricky L. Boydston
Robert B. Breneman
John R. Bricarello
Kristin C. Brier
Paulus W. Bruins
Steven Wayne Buckner
Timothy R. Buhl
Steven R. Burke
Fitzhugh G. Bush
Greg L. Butters
Kirk W. Butz
Steven C. Carey
Gilberto Carrillo
George F. Carroll
Steve R. Christensen
Stanley M. Clark
Timothy C. Collins
Jennie S. Crowley
John L. Dabritz
Richard M. Dahlgren
Phillip L. Dahlstrom
George L. Dale
Val R. Debrunce
Gary J. DeJong
Gerald L. Delker
Travis M. Dinoff
Gary S. Ditta
James S. Drage
Adrienne E. Drobnies
Darryl S. Dumke

Raymond Duncan
Lynne M. Dunlap
Thomas A. Early
Rudolph W. Eden
Alan P. Edwards
Don S. Edwards
Richard L. Ehrhart
William A. Eklund
Eric M. Eliason
Teresa K. Elrod
Michael J. Epstein
Gordon L. Epstein
Stephen W. Eubanks
Jennifer J. Everett
Ranny A. Fields
Mark P. Fletcher
Richard V. Folger
Michael R. Fondiller
Timothy A. Fondiller
Lois Y. Frasca
William P. Freeman
Mark E. Frink
William M. Fruscella
Laura L. Fuller
Sharon T. Gaffney
Kevin P. Gallavan
Peter Gifford
Gail A. Graham
Carl D. Gregory
Charles Grissom
Frederick H. Grose
Karl R. Grose
Ronald L. Halterman
Bruce R. Harris
Sharon F. Harris
Ralph A. Hartman
Dennis M. Herbert
Fred H. Wilcoxon III
Ernest R. Hogue
Jeffrey N. Hollander
Richard J. Holloway
Joseph E. Hourigan
Bruce M. Howard
John M. Hughes
Fred Hulderman
Steven Iles
Michael J. Incorvia
Alan E. Ingall
Hisashi B. Iwahashi
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Mary M. McKown (nee Young)
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