7. Physics Courses and Degree Programs

Physics About 1928

Physics in the early part of this century and its forerunner natural philosophy were usually described as the study of mechanics, heat, sound, magnetism, electricity and light.

The first degree in physics was granted by the University of Arkansas in 1928. This first degree was a B.A. degree and the second in 1931 was a B.S. degree.

When this first physics degree was granted the *University Bulletin* published that year listed the above courses plus electrical measurements and electron theory for a major. Thirty semester hours of physics were required for the major in physics.

The 1928 Bulletin defines the requirements for both the B.A. degree and B.S. degree. The B.S. degree required a greater total of science courses and included one or two science minors. Certain other details about the degree requirements involved a listing of four groups of courses.

Then the four groups from which elective courses are to be chosen are listed. The details of these four listings will be shown here, but the additional five pages of details and constraints will not be gone into! Suffice it to say that it takes less than two pages in a 1990's catalog to define the requirements for the Bachelor of Arts degree and about one page to define the basic requirements for the Bachelor of Science degree in Fulbright College!

Group I: English, French, German, Greek, Italian, Latin, and Spanish.

Group II: Astronomy, Botany, Chemistry, Geology, Mathematics, Physics, and Zoology.

Group III: Economics, History, Philosophy, Political Science, Psychology, and Sociology.

Group IV: Agriculture, Bible, Business Administration, Education, Engineering, Fine Arts, Home Economics, Journalism, Law, Medicine, Military Art, Physical Education (for women), Public Speaking, Social Welfare.

This grouping was to continue with little change until the general education program was developed within the College of Arts and Sciences in the early 1950's.

The three physics teachers in 1928 were G. E. Ripley from Purdue University, Dr. S. R. Parsons from the University of Michigan and W. M. Roberds from the University of Kansas. Roberds completed work for the Ph.D. at the University of Kansas while on leave for a semester in 1935.

There were a total of ten courses listed in the 1928 Bulletin of the University and seven were above the introductory level. Some of these were taught only in alternate years.

The seven courses above the introductory level were Heat and High Temperatures (233), Light (243), Electricity and Magnetism (313), Electrical Measurements (323), Mechanics (333) and Electron Theory (343). All of the upper level physics courses except the first two were taught in alternate years.

Electrical measurements and electron theory were the only courses required of the major not included in the original physics-natural philosophy list.

The electron theory course emphasized the study of electrical discharge in gases and had become a vital part of physics. A textbook *Ions, Electrons and Ionizing Radiations* by J. A. Crowther of the University of Reading (Longmans, Green & Co.) went through several editions in the 1920's and 1930's and is a good outline of the materials being taught then.

Electrical measurements courses were an active part of physics at that time. Potentiometers, bridges, galvanometers, quadrant electrometers, standard cells and other classical electrical measuring devices were a vital component of the physics research laboratory. Photography coupled with photometry and the thermoelectric effect and ionization and scintillation phenomena were major radiation sensing elements in research.

The development of electrical engineering also was strongly coupled with the development of good electrical measuring devices. J. J. Thomson is credited with having invented the

watt-hour meter!

The 1927-1928 University of Arkansas *Bulletin* describes the Physics Building shown in Chapter 3, page 19. This is a two-story frame building containing ten rooms for lectures and laboratory work in physics. It was located southwest of Old Main.

Modern Physics

The above course listing for a physics major was indeed similar to the listings in most colleges and universities then. The basic principles of quantum mechanics were only being developed in the 1920's and it would take a little time to get the new quantum mechanics incorporated into the training of physics students.

Several good books did cover the broad field of atomic physics or modern physics. One of the first major textbooks on modern physics in English was written by F. K. Richtmeyer of Cornell and published in 1928. The masterfully written textbook *Atomic Structure and Spectral Lines* by Arnold Sommerfeld in German was published first in 1919 and in its fifth edition in 1931. A pedagogically useful *Atomic Physics* book was put together by members of the University of Pittsburg staff in 1933. This text was taught by L. B. Ham in the 1930's and later in the 1940's by Paul C. Sharrah. By that time all of the physics majors and most of the chemistry majors were taking this one-semester course

But the training of persons really qualified to teach a bona fide course in quantum mechanics was slow in developing. The first text in quantum mechanics was written by Condon and Morse in 1928 but many of the graduate schools in the 1930's and even the early 1940's had faculties who were trained only in classical physics! Thus most of those obtaining graduate degrees in physics in the 1930's and 1940's would be exposed to only one semester of quantum theory and possibly a course in atomic physics and a course in nuclear physics. Solid state physics was being introduced into the graduate schools also by the 1940's.

The first true course in quantum mechanics was introduced at the University of Arkansas in 1948 or 1949. Dr. H. M. Schwartz was the teacher. This was expanded to a two-semester course in 1954 and this two-semester sequence is still listed in 1995. A course in advanced quantum theory was introduced in the early 1970's and it was taught initially by Dr. Michael Lieber. A quantum optics course was introduced around 1980.

A two semester course in atomic physics for senior and first year graduate students was introduced at the University of Arkansas in 1960 using the excellent text by Robert B. Leighton. Dr. O. H. Zinke was the first to teach this two-semester sequence and the enrollment was close to 15 students. Dr. Charles E. Jones also taught the course for a time and it continues to serve a need. This atomic physics course is listed as a prerequisite to QM I.

The above senior-first year graduate course was in addition to a one semester atomic physics course taught at the junior level It had been taught since the early 1930's and, as mentioned above, the first textbook used in this course was a book of the same name published by the University of Pittsburg Staff. During the 1960's a book written by Henry Semat also served this course very well.

A sophomore-junior level course in modern physics for engineering students was introduced at the request of the college of engineering in the early 1960's. Engineering Dean George Branigan had just returned from a conference in which the point was strongly made that engineering students must be exposed to modern physics in some form or other. He worked closely with the physics department in the details of initiating this course. At first the course was completely devoted to nuclear physics and reactor theory (text Irving Kaplan) but soon it was changed to cover the broad field of modern physics, including some material on solid state physics. A course with this general description is still taught as University Physics III with a laboratory available.

Classical Physics

While the above discussion shows proper concern for teaching modern concepts in physics, some defense is needed for the classical subjects, especially in the introductory courses and courses for the major.

Let us say a few words about what physicists

were doing professionally and are still doing. For decades one would hear someone complaining that a teaching job is the only type of job a physicist could get. One professor at the University of Missouri in 1940 said that he didn't want to turn out too many physicists because they would be trying to get his job!

Indeed it was well into the twentieth century before physicists found their place in industry and government. Physics proved itself to be practical and useful and the technological advancements of the last hundred years rest heavily on physics developments. Physics had a strong impact on several of the military developments during WW II. Sonar, radar and the nuclear bomb are only a few of the areas where physicists and their knowledge were critical.

Physicists now work side by side with engineers and when the physicist excels it is in part because of the breadth of his training. Let us continue to produce broadly trained graduates who are useful in industry in a wide spectrum of research and development work as well as in teaching.

While the leading edge of research is almost entirely modern physics based, a significant fraction of the jobs held by physicists in industry and government is related to classical physics.

1934-35 Catalog

The 1934-35 physics faculty consisted of Professor Ripley, Assistant Professor Ham, and Mr. Roberds!

The list of courses has risen since 1928 from ten to thirteen with eleven courses above the introductory level.

The 1934-35 catalog still lists 30 semester hours as the requirement for the physics major, apparently the B.A. degree.

Calculus is required for the major and a course in differential equations and a course in partial differential equations of mathematical physics are recommended.

The B.S. science requirements included 33 hours in one science and two minor science subjects totaling 27 hours, or a major subject of 27 hours and two minor subjects totaling 33 hours. At least four general introductory science courses were required and a maximum of 90 hours of all science courses were allowed toward the degree. In addition to the general requirements, the degree included 16 hours of one or two foreign languages and 12 hours of social science.

The physics courses listed are rather standard for the period. The list includes electricity and magnetism, atomic physics, heat, x-rays, acoustics, sound, photography, light and photography and introduction to theoretical physics. Sound and light and x-rays are taught at two levels. One level is for the general students and the other is for physics majors! The x-ray course, for example, had all of the students together for some lectures with an additional session devoted to specialized advanced subjects, as x-ray diffraction.

A mechanical engineering junior-level course in mechanics "may be counted toward the requirement for a major or a minor in physics." This was the only advanced mechanics course in the physics program at that time except for what was taught in sound and in the theoretical physics course.

For some unknown reason, the electrical measurements course is now absent from the curriculum. It was in the 1928 catalog and was very prominent in the 1940's and 1950's. The credit permitted in the advanced laboratory had been increased to six and presumably some of this work could include electrical measurements.

The 1934 catalog still lists two introductory physics courses of essentially the same design except for prerequisite. One is for students who have not had high school physics and the other is for the students who have had a high school physics course.

At later times mathematics is treated as the primary prerequisite for the introductory physics courses with less attention being paid to whether or not the student had physics in high school.

The one astronomy course is listed in the department of mathematics and astronomy and is taught by Assistant Professor Richardson.

The mathematics courses go as high as partial differential equations, functions of a complex variable, higher geometry and an intermediate level course in the theory of equations and determinants.

Introductory Courses

It was noted that the 1928 and 1934 *University Bulletins* listed a general introductory physics course for students who had studied physics in high school and a similar course for those who had not taken such a course. No description of the course is given but these two-semester courses were to be taken by physics, engineering and premedical students. One of the catalogs in this period does list the physics textbook by Millikan and Gale. That does amaze the author, because his first high school physics course used the text prepared by Millikan, Gale and Pyle and his first college physics course used the text prepared by Millikan, Gale and Edwards.

By 1942 two introductory courses were still being taught but with a major change in structure and purpose. An eight-hour college physics course, including laboratory, was taken by science and pre-medical students. It was taken normally during the sophomore year.

The second course being taught in 1942 was a ten credit-hour course called engineering physics. It had a unique structure. The engineering students took a two credit-hour course without laboratory entirely devoted to introductory mechanics in the spring of the freshman year. Then during the sophomore year an eight credit-hour engineering physics course was taken again principally by the engineering students with a few science majors. This two-semester sequence included a one credit-hour laboratory course each semester.

This unique three-semester, ten credit-hour course, for the engineering students was very successful and was the pride of both the physics department and the engineering college. The department was complimented more than once for the progress made by the engineering students in this three semester offering. But course scheduling and staff shortage pressures had reduced the engineering physics course to a fairly standard eight credit-hour course by the 1950's!

Equally interesting is the history of the development of the introductory physics laboratory course offerings. These laboratory exercises emphasized the principles of measurement and significant figures and used experiments to demonstrate and fortify the material presented in the lecture course. Some students of the field have pointed out that the list of experiments in the elementary laboratory today is very similar to the list initiated at Harvard in the 1880's.

Richard J. Anderson

Early in the physics program, intermediate level laboratory exercises were also introduced in heat, light, sound and electrical measurements. A photography course was often included in physics department offerings. In many schools the electrical measurements course would be required of the electrical engineering students.

Urbano Oseguera

A novel but effective advanced undergraduate laboratory course was offered at Arkansas under the course title Industrial Physics. This was a variable credit course which could be taken for a total of four semesters for a maximum of six credit hours. During the 1940's this course provided good training for a number of physics majors and was frequently elected by engineering students and students majoring in other sciences.

An electronics course has been offered in physics for some time. Initially of course the course emphasize vacuum tube circuitry but revolutionary changes took place with the developments in semiconductors and the invention of the transistor.

A laboratory course in x-rays rounded out the early advanced laboratory offerings at Arkansas, up until about 1970.

One significant change in the operation of the elementary laboratories took place in the 1970's. The book *Lab-oratory Experiments in*

Physics by Schneider and Ham (published by the Macmillan Publishing Company in the 1930s) had been used for over three decades. While it had undergone several revisions, some of the material was becoming dated and it was decided to produce an "in house" laboratory manual. Richard J. Anderson developed the first version and he and the department decided to let whatever income accrued to be used to fund freshman scholarships in physics. This proved to be very successful and each year as many as ten freshman scholarships are granted. Urbano Oseguera produced a completely new version of the "in house" physics laboratory manual in 1990.

Gregory J. Salamo developed a physics laboratory for architects in the late 1970's and also prepared a laboratory instruction manual.

Astronomy laboratory instructional materials have been prepared by Charles B. Richardson, Carol Webb, and Claud H. Lacy.

Another significant feature of the elementary laboratory operation has been a weekly meeting with the teaching assistants to look over the experiments and the laboratory set ups for the following week. Grading procedures and testing and general problems of laboratory management are also discussed. A member of the faculty is coordinator of all these activities. Those who have served as laboratory coordinator in the physics and physical science laboratory since 1954 have been L. B. Ham, George D. Lingelbach, Paul C. Sharrah, Glen T. Clayton, Richard J. Anderson, Michael Lieber, Donald Pederson, A. S. Hobson, O. H. Zinke, Urbano Oseguera, and Charles B. Richardson.

J. Brad Shue

Even as late as Spring 1993 the first semester laboratory exercises were listed as measurements and errors, specific gravity & Archimedes Principle, static equilibrium, acceleration of free fall, projectile motion, circular motion, elastic collisions, moment of inertia, inelastic collisions, temperature and phase change, simple harmonic motion, simple pendulum and standing waves.

Gay Stewart

The Spring 1993 second semester laboratory exercises were listed as charge of the electron, electric fields, magnetic fields, current balance, Coulomb balance, oscilloscope I, oscilloscope II, capacitance, A. C. Circuits, microwave optics, geometrical optics, radioactive decay and diffraction grating.

As was pointed out above, all but three or four of the above experiments could have been done at Harvard in the 1880's!

Finally in 1992 the department was defining again its needs and goals in teaching, including laboratory management. Somewhat better space for storage and development of laboratory and demonstration devices was being made available again with the renovation and expansion of the physics building.

A new college graduate, J. Brad Shue, from Appalachian State University in Boone, North Carolina was employed with the title Instructor and Equipment Curator. He came with a very strong background in laboratory and demonstration teaching devices and the use of computers. Many new pieces of laboratory teaching apparatus were purchased and a few new and spectacular demonstration devices visible in the large lecture halls were being developed. A third version of the "in house" physics laboratory manual was again needed and was being developed by Charles B. Richardson and J. Brad Shue. Gay Stewart, a new Ph.D. from the University of Illinois, is developing and directing the second semester University Physics course with the lecture, drill and laboratory work all combined in three one and one-half hour sessions. She and J. Brad Shue are also making good use of the desk-top computer in teaching and in peer communication via bulletin boards through Internet.

1944-45 Catalog

The catalog published April 1, 1945 includes the announcement of courses for the 1945-46 school year. The army groups of WW II and the dozen or more faculty brought in from other departments on campus to teach physics are gone.

The 1944-45 catalog lists the prescribed courses as English, Military Art (for men), or Physical Education (for women), 6 (term) hours, to be taken in the freshman and sophomore years.

The twelve-week term system implemented briefly during WW-II to accommodate the army training groups is gone. The University is to return to the eighteen-week semester system for fall 1945 classes. This change was announced at the last minute and the course announcements were somewhat confused.

The student enrollment in the University was to more than double during the three or four years following the war; from around 2,000 students in 1944 to over 5,000 in 1948! We had a 2,000 student faculty teaching 5,000 students! But we survived and did a pretty good job teaching, but the research efforts within the department were still very slow to develop!

The 1945-46 announcement still shows only three faculty members in physics, L. B. Ham, Paul C. Sharrah and J. Bruce Kellar. Robert Morse joined the teaching group later as an instructor. A fourth part-time teacher was a common practice for a few years in the 1940's and 1950's. These included Camus, Antoine, Raible, Doughty, Testermann, Bennett, Leonard, Good, Damon, Oxford, Clayton, Williams, Jones, Harvalik, Sauer, Nurmia, Scobie, Saporoschenko, Bolling, Pierce and others.

The 1945-46 announcement still defines the B.A. degree and the B.S. degree very much as they were defined in 1928. The B.S. degree program requires a 30 hour major, one 18 hour minor and a minimum of 60 semester hours in science courses in three departments and four introductory science courses. The B.S. program required mathematics through differential equations.

The B.A. degree program also required 30 semester hours and mathematics through calculus only.

There was still considerable belaboring of the Group I through Group IV requirements and, as was mentioned above, this listing of groups was to continue with little change until the general education program with a core curriculum was developed within the College of Arts and Sciences in the late 1940's under the leadership of Dean Guerdon D. Nichols.

The number of courses offered in physics had exploded by 1945 to twenty-eight courses and this number did not include the elementary laboratory courses! How could these be taught? Several were taught only in alternate years or on demand! No junior-level mechanics course is offered and a course in engineering frequently was used to supplement the physics offerings in this area well into the 1950's.

Photography was soon dropped from this listing as it had not been taught since Dr. Roberds resigned in 1942.

The elementary courses had large enrollments as the GI's came to college in large numbers. Most of these sections had seventy five students for a total of about 300 students in introductory physics.

Physics majors were being taught and most of them took courses in mechanics, electricity and magnetism, electrical measurements, electronics, heat and thermodynamics, sound, light, x-rays, atomic physics, and introduction to theoretical physics. The x-ray course would continue to be a significant part of physics for twenty five years, when the department of chemistry developed a strong x-ray diffraction program.

The one astronomy course, "descriptive astronomy", was taught by Dr. Guerdon Nichols in the Department of Mathematics and Astronomy.

The advanced mathematics program listed essential the same courses as those listed in 1934 with the addition of a course in the theory of numbers and a course in statistics.

General Courses

As the general physics courses became more mathematical and contained material more relevant to science and engineering majors, fewer and fewer students took physics as a part of an overall general education program. One of the first attempts to correct this trend was the

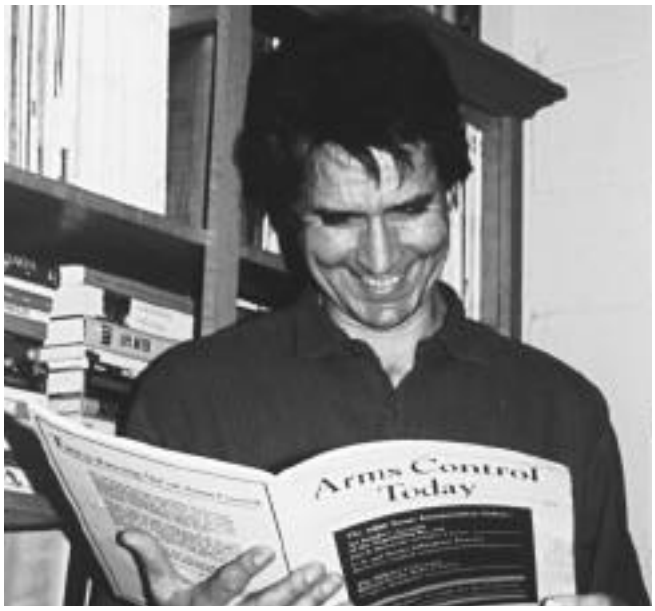
introduction of survey courses in physics and the other sciences. A survey course in physics was taught from 1946 to 1958 when it was deleted in favor of the two-semester physical science course with laboratory.

A one-semester course entitled "Physics in the Home" was required of the majors in home economics and was taught from 1945 until 1958. A few of the items collected by Ham for this course can still be recognized in the laboratory.

A short course in physics and meteorology was taught by Ham and Sharrah for two years just prior to WWII as a part of the Civilian Pilot Training Program. A physics syllabus had been prepared for the Program.

If you like beautiful memories about good days in teaching, you will want to hear about the thrust put forth in the College of Arts and Sciences in the early 1950's. Under the leadership of Dean Guerdon D. Nichols, the College went to the top of Mt. Olympus in its push for general education. While the primary goal of the 1951 Ford Foundation Grant of totally revolutionizing teacher education was not accomplished (Ref 3, pp.190-195), the general education program and the honors program born during this travail would thrive.

Broadly based general education courses at the introductory level were developed in several areas. A physical science course with laboratory was initiated in 1951. Arts and Sciences Dean Guerdon D. Nichols offered to send Sharrah to Harvard for a year to study and observe the course being taught by Professor James B. Conant! Why didn't he go? He thought the University needed him!



A. S. Hobson,
Fellow of the American Physical Society, 1992

Three separate courses were tried out on an experimental basis. One was taught by more than one teacher, each teaching material close to his discipline. This was probably the best idea but the time required exceeded the teaching credit one could receive and this along with the added administrative work caused it to disappear.

Dr. William C. Noyce of chemistry, Dr. B. H. Gundlach of mathematics, Dr. Paul C. Sharrah, Dr. Kern C. Jackson of geology and Dr. Z. V. Harvalik of physics and the Institute of Science and Technology all contributed much to the early phases of the development of the physical science courses. Later Dr. O. H. Zinke and Dr. A. S. Hobson taught many of the large physical science sections and continued to develop the course during the 1960's and 1970's. In relatively more recent times these and similar courses have profited by the work of Dr. Lothar Schäfer and Dr. George D. Blyholder of chemistry.

For several years the physical science course was a two-semester six credit-hour course, later changed to a one-semester course for four credit hours taught by the Chemistry Department.

The physics department took over the astronomy teaching in 1967 and it was scheduled at night. Enrollment rose to over one hundred students. Then when the beginning course was expanded to include laboratory in 1972, astronomy also was used by several colleges to satisfy the general requirement in physical science.

A very successful physical science course for elementary teachers was developed by Dr. Glen T. Clayton of the department of Physics about 1971. Dr. Richard Anderson gives a discussion of the concept and implementation of this course in Chapter 6.

Somewhat in a different vein and for a different purpose, a broadly based intermediate level physics course called "Energy and Society" was developed by Dr. O. H. Zinke in the early 1970's. This was during the "energy crunch" and the course was used primarily by the geology depart-

ment. O. H. Zinke and Paul C. Sharrah taught this course for two or three years.

An interdepartmental course in geophysics was offered for a few years principally in the early 1950's. This course was taught by Dr. L. B. Ham from physics and Dr. Kern C. Jackson from geology.

An interesting but somewhat lonely effort has been the development of a course entitled "Physics and Human Affairs." This course, developed entirely by A. S. Hobson, is a one-semester course with laboratory and satisfies the general education requirements in Arts and Sciences and in Business Administration and in Education. At first the laboratory was essentially the same as that developed for the general physical science course, but it has been gradually modified better to meet the goals of the new course. Hobson has published two books for use as the text for the students: *Physics and Human Affairs* (Wiley, 1982, now out of print), and *Physics: Concepts and Connections* (Prentice-Hall, 1995).

This "lonely" effort can better be described in Dr. Hobson's own words: "During 1964-74 I taught Physical Science a few times. I thought that it wasn't very relevant to the needs of non-scientists and began revising it to be more socially and philosophically inclined. About 1974 I began agitating for a new physics course, Physics and Human Affairs (PHA), which would include physics and its societal and cultural and philosophical connections. The physics faculty was fairly friendly although not really supportive of the idea, and the rest of the University was very suspicious. Richardson was chair at the time. The University's academic programs people didn't want to expand the courses that will fill the science requirement for nonscience students, they didn't like the social content, they didn't like the interdisciplinary aspects of the course. They thought it was too "non-scientific," too "soft," and too non–traditional. It took three years of hard politicking to get PHA on the books, uphill all the way.

"I began teaching the new course, from my own notes and from a traditional liberal-arts physics text (Paul Hewitt, *Conceptual Physics*), about 1977. The first semester the enrollment was about 10, but it increased each semester. After a few years, it was up to its present 220 (or so) each semester. In 1978, I began writing up my course notes to hand out to students, as a sort of textbook. These notes soon evolved into the beginnings of a textbook, which several publishers then got interested in. I signed a contract with John Wiley & Co. in 1979, and it was published by them as Physics and Human Affairs in 1982. Pederson was chair during most of that time. I got little, if any, support from the department for writing the book, and no departmental rewards (research "points," pay raise, etc.) for publishing it. I put four years into writing it (mostly during summers). I argued that the book was the equivalent of research, but Pederson felt it was not. I got some "teaching" credit for the book, but no "research" credit, which meant that my pay raises suffered a lot during about 1978-84. It was a typical case of the way U.S. universities penalize their scientists for paying much attention to education, and a good example of what is wrong with science in our country. At one point, Dean Guilds actually called me into his office to try to talk me back into doing traditional physics research instead of the teaching-related and societal-related work I had been doing.

The course was very successful. A year ago, I signed a contract with Macmillan Publishing Co. for a new book, Physics: Concepts and Connections, published in 1995. It is much more complete and more broadly appealing to other physics teachers, than the previous book. The course is always full, with a long waiting list. I recently got an OK for a third teaching assistant to teach labs, increasing the number of laboratories from ten up to 15 per semester, allowing 330 instead of 220 in the class every fall and spring. The 330 seats were filled up immediately during pre-registration for spring 1995, and I am happy to go to two sections per semester, of 200 students per section, beginning in the fall of 1995. There are also two sections in the summer, at 50-100 students each. The colleges of business and education both encourage their majors to take the course in Physics and Human Affairs, in addition to the A&S students who take it.

"My goal is to revise the teaching of liberal-

TABLE 7-1

(PLAN A) UNIVERSITY OF ARKANSAS
B.S. Program (physics) (NOV. 1960)

FRESHMAN

FALL		SPRING	
English	1013	English	1023
Calculus	2555	Calculus	2565
Physics 1 (II, S)	2053 & 2071	Physics 2 (I, S)	2063 & 2081
Chemistry	1104	Chemistry	1114
Speech	1302		
ROTC	1 (19) (4)	ROTC	1 (17) (4)

SOPHOMORE

FALL		SPRING	
Modern Physics 3 (II)	2613	Elec. & Magnetism	3413
Elec. Measurements	3423	Vac. Tube Circuits	3443
Calculus	2573	Differential Equations	3043
Biology	1004	Biology	1014
Fine Arts	1033	Fine Arts	1133
ROTC	1 (27) (6)	ROTC	1 (17) (6)

JUNIOR

FALL		SPRING	
Mechanics	3113	(Sound)	4213
Atomic Physics (II)	3643	(Solid State)	4713
Physical Optics	3543	(Atomic & Nucl. Lab.)	4623
(Math.)	3	(Math.)	3
Western Civilization (S)	3	Western Civilization (S)	3
Language	5 (20) (9)	Language	5 (20) (9)
		English*	3603 & 2013

SENIOR

FALL		SPRING	
(Heat & Thermodynamics)	4113	(Intro. to Spectra)	4513
(Physical Optics Lab.)	4553	(Geophysics)	4433
World Literature	1113	World Literature	3
Group III	3	Group III	3
(Language)	5	(Language)	5
(Atomic Physics)	4633	(Atomic Physics)	4643
(Intro. Theor. Phys.)	6813	(Intro. Theor. Phys.)	6813
(Math.)	3	(Math.)	3

NOTES (Plan A)

The physics and mathematics courses are usually taken in the order shown. The other courses may be scheduled as desired. The schedule shown above is for an accelerated program. Freshmen who are not prepared to take Math. 2555 will substitute Math. 1284 or Algebra 1203 and Trig. 1213. Physics will then be started during the second semester or in summer school and it is recommended that Math. 2555 and Physics 2053 be started simultaneously. The physics courses listed in the first three years are adequate to complete the requirements for the major in physics. The courses in parenthesis are not specifically required but are frequently elected. Up to six hours of selected courses in advanced mathematics, chemistry, and engineering may count toward the 36 hour physics requirement. Physics courses marked with an (S) are normally taught in summer school also. No one student is likely to take all of the courses listed under the senior year but most students will wish to elect some of them. A student within 12 hours of graduation may enroll in advanced courses for graduate credit. Students who expect to continue with graduate studies are encouraged to study more than one foreign language.

*Exemption allowed by special examination before senior year.

arts physics in the United States, away from the traditional watered-down "straight physics" courses taught every place today, toward a more humanistic, cultural, socially-conscious course like PHA. This has happened, successfully, on this campus, and I hope that the new book will stimulate such an evolution around the nation." Quoted with only editorial changes from material submitted by Dr. Arthur S. Hobson in December 1992 and edited February, 1995.

An editorial explanation is in order. One reason the physics faculty was a little cool on the Hobson course at first was because of what seemed to be a rather excessive amount of time spent on the problems of nuclear war and the other massive military weapons. All agreed that there was a problem but questioned the wisdom of using this course as a forum for this debate. This obsession with military matters seemed to displace the very emphasis on physics and philosophy which the course claimed to cover! But all of this, fortunately, has come better into balance both locally and internationally. The PHA type course may just make it!

Another editorial comment is in order. Dr. Paul Hewitt was a professor at the University of San Francisco and his popular book "Conceptual Physics" mentioned above was no ordinary physics text. This highly successful text created much thoughtful discussion about physics, both among students and teachers. This and other service rendered by Dr. Hewett brought him honors from his peers in the American Association of Physics Teachers. He was the keynote speaker when the Arkansas-Oklahoma-Kansas section of the American Association of Physics Teachers met in Fayetteville in 1974 and he made a major invited talk before the AAPT meeting in San Francisco in 1978.

Dr. Arthur S. Hobson rendered excellent service to the physics community and to the American Physical Society in its new section Physics and Society. He also became editor of its Newsletter in 1985. This work along with his other service brought him the honor of becoming a Fellow of the American Physical Society in 1992.

Thus our department has the distinction of having three Fellows, the other two being Raymond H. Hughes (1968) and William G. Harter (1995). Allen Hermann was designated a Fellow of the American Physical Society for work done on the lithium battery before joining the University.

More information on faculty professional activities and service will be presented in Chapter 9.

1960 Physics B.S. Program

While we are viewing "snap shots" of the progress of the physics offerings throughout the years, we are fortunate enough to have a copy of the recommended B. S. program of study being handed out to freshmen physics majors in the early 1960's. A copy of that program is shown on the following page as Table 7-1.

There had been some changes since 1928 and 1944, the reference points discussed above! The B.S. program of study now required 36 semester hours in the major field with 136 credit hours total. The B.A. program of study now required 30 semester hours in the major field with 124 credit hours total.

This 1960 recommended program of study for the B.S. degree on page 73 is of special interest because this was approximately the program of study during the peak decade of the production of undergraduate physics degrees.

This Plan A "accelerated program" started Engineering Physics, later called University Physics, in the fall semester of the freshman year simultaneously with calculus.

There was another B.S. program, "a Plan B", which started physics during the second semester of the freshman year, again simultaneously with calculus. This brought about delaying the intermediate and advanced courses about a semester or a year. Unfortunately no copy remains of this modified schedule but certain aspects of it are introduced in the NOTES at the bottom of the sheet. It is known that many freshman students not quite ready for calculus did make use of it.

Another thing not evident from a study of this 1960 schedule is the emphasis that was being placed on honors studies. This program was developing rapidly. Honors sections of the two-semester introductory courses were taught. A junior-level honors course of independent study was introduced. An honors colloquium was also

a part of this program for a time. The college honors program is discussed later in this chapter.

A very significant strengthening of the undergraduate degree program was the introduction of the two-semester atomic physics course in the senior year listed on page 73. Sometimes in the late 1950's and early 1960's there would be as many as fifteen students in this course as it could be taken by both seniors and first year graduate students. A course similar to this is still being taught in 1995.

Also noted in the 1960 B.S. program, there is the recommendation that those planning on entering graduate school should take two foreign languages! This last requirement would soon be relaxed to require only one foreign language, Russian or German. Then by 1969 even this foreign language requirement was completely eliminated! English had won!

1969-70 Catalog

We are looking somewhat by accident at the six bulletins or catalogs for 1928, 1934, 1945, 1969, 1982 and 1993, along with the 1960 B.S. program in physics. These "snap shots" of history are interesting and informative.

The 1969-70 bulletin lists twelve physics faculty members and forty courses, exclusive of elementary laboratories.

A bachelor of science in physics and a bachelor of arts in physics are defined. The B. A. degree program requires 124 semester hours and the B.S. program requires 136 semester hours.

The B.S. degree program required 36 semester credit hours in physics and the B.A. program required 30 semester hours. The B.S. degree also had more courses required in advanced mathematics. This included a course in differential equations and two additional courses to be selected from an approved group. Most of the physics students elected the two-semester course in applied mathematics or the two-semester course in advanced calculus.

Several of the advanced physics courses have been expanded to two or three semesters and many of the courses are taught on demand or in alternate years in their description. Mechanics is now in a three semester plan, electromagnetic theory is a two semester course, quantum mechanics is taught in a two-semester sequence and a new course in quantum theory was introduced the next year.

A one-semester course in relativity is also available. Courses in plasma physics and elementary particles will follow soon.

A one-semester course in mathematical physics was also introduced at about this time as it was determined that too much time was being used up in the advanced courses teaching the necessary mathematical tools.

At the introductory level a third semester has now been included in the University Physics course taken mainly by science and engineering majors. This is now called modern physics. This course had been nuclear physics and reactor physics when it was initiated in 1960 but in a year or two it was modified to cover the broad field of modern physics.

Six of the courses are listed as primarily satisfying certain requirements for prospective science teachers and most of these courses were used from time to time for teachers in the summer institutes.

The general education program first established in the early 1950's is clearly defined. Certain basic courses are required of all students including general education courses listed in three groups. These three groups are I. Literature and Fine Arts, II. Natural Science and III. Social Studies. This general education program was very successful under Dean Nichols when the faculty received due credit for teaching and was rewarded for developing and teaching these general courses.

The physical science course satisfying the general education requirements consists of two semester courses of three credit-hours each. Sharrah and Zinke are listed as the teachers.

The descriptive astronomy course and two additional astronomy courses are now being taught by the department of physics. The two new courses are observational astronomy and advanced astronomy. A popular one credit-hour course in celestial navigation was added the next year. Its description sounded very much like the practical astronomy course Professor Droke had taught a half a century earlier. But he didn't have the bubble sextant.

The mathematics program now included algebraic theories, Laplace Transforms, numerical

analysis, vector analysis, advanced applied mathematics, abstract algebra, sets and logic, groups, Hilbert space, differential geometry etc. Another notable feature of the mathematics offering is the courses somewhat directly related to the use of computers. These include numerical analysis, digital computer programming, computer science and linear programming.

B.A. Thrust in the 1970s

An expanded B.A. degree program in physics was initiated in the 1970's. The number of B.A. degrees granted in physics took a jump in the decade that followed and the number of B.A. degrees granted in physics actually exceeded the number of B.S. degrees. Even during the decade of the 1960's whenthe production of physics degrees locally was at its peak, the number of B. A. degrees granted still fell far short of the B. S. degree production! (See Table 7-2).

Table 7-2
Undergraduate Degrees*

B.A./B.S.

		B.A.	B.S.	Total
Degree Total	1928-1959	10	62	72
Peak Decade	1960-1969	7	99	106
Peak B.A.Decade	1970-1979	44	41	85
Decade	1980-1989	27	37	64
Six Years	1990-1995	1	13	14

*Complete degree production data is shown in Chapter 10.

This sudden increase in the number of degrees granted and in the B.A. program in the 1970s was no accident but was the result of a well planned and orchestrated move.

This exciting and productive program resulted primarily through the imaginative work of Dr. Richard J. Anderson and Dr. Glen T. Clayton. It was designed to prepare students to enter professional fields needing a strong science basis and a strong background in general education but not normally for those expecting to take up graduate studies in physics.

Both the B.S. and B.A. degree programs had co-existed from the very beginning of the University. While the details varied throughout the years, the B.S. program always had a strong emphasis in science and mathematics while the B.A. program permitted a broader range of studies in other fields. In the very early days the B. S. program and the B. A. program for a time actually required the same number of courses in physics and the B. S. program placed emphasis on German and other European languages needed for advanced work in the sciences! By 1928 the B.S. degree required a greater total number of science courses and included two science minors.

By 1970 the B.S. was definitely "recommended for those interested in graduate work in physics or professional employment," while the B.A. was for "the student who wants to take a broader program of study in the arts and social sciences while majoring in physics" (1969-70 Bulletin). The two programs still drew on the same list of courses with only the total number of physics and mathematics courses and general education courses being different. The B.S. required a greater number of courses in both physics and mathematics. The B.S. program in physics required 36 hours of physics (total 136) and that the B.A. program required 30 hours of physics (total 124).

The number of hours and especially the details of the course selections for the B.A degree in physics were to be modified drastically during the 1970's, as signs of change were evident. The department was diligently trying to find new areas of service to bolster its enrollment figures. An ill-fated attempt was made in the early 1970's to develop a program to "train" physics majors for industry using the B.A. program, for example.

A memo prepared by Professor Michael Lieber in 1993 describes the effort to use the B. A. program to prepare students for industry and the far more successful plan to emphasize the B.A. degree for students heading into the professions, especially medicine.

"The situation changed in the early 70's. At first the department thought it might develop the B.A. into a distinct applied physics degree, somewhat along the lines of the program at Yale. To this end an industrial physicist from Gulf-General Atomics Corporation, Dr. Alan Larson, was hired to assist the department to

develop the industrial connection. However, we quickly learned that industries preferred a general, conventional physics background based on the hard core B.S. program. The Applied Physics program died, and Dr. Larson moved on to Georgia Tech. in Atlanta, Georgia.

"However, in 1971, Prof. Richard J. Anderson and the Undergraduate Affairs Committee he headed, refashioned the B.A. program, creating three new courses with an applied and lab-oriented flavor: Physical Mechanics (mechanics with an acoustics component), Fields and Waves (practical electromagnetism) and a course in Modern Physics (with laboratory). The new program was based on the non-calculus introductory course, had fewer mathematical requirements, and fewer and less mathematical upper level physics courses (a total of 24 semester hours of physics as compared with the 36 for the B.S.), but required the student to do 9 hours of approved junior-level work in a "secondary emphasis" area, such as agriculture, chemistry, zoology or even physics (for those who started out on the B.A. path and later decided to go to graduate school in physics).

"Stimulated by "seed money" in the form of six $400/year scholarships, the new B.A. program proved quite successful for a while — at one point there were over 40 B.A. majors, about the same as the number of B.S. (As pointed out earlier, the number (71) of B.A. degrees granted in physics during the twenty year period 1970 to 1989 almost equaled the number of B.S. degrees granted during that same period.)

"The largest B. A. group proved to be the premeds. They found that having physics as a major, rather than the far more common biology or chemistry major, made them stand out. For a while we had a 100% acceptance rate into medical school!

"Gradually, the number of students in both programs began to fade, but the B.A. faded more rapidly. ——— Currently (1993) there are only a handful of B.A. majors." End of 1993 Memo prepared by Professor Michael Lieber.

The following informative Memo was prepared in 1994, by Dr. Richard J. Anderson, the principal proponent of the very successful B.A. program developed at Arkansas to educate physics students for the professions.

This report from Dr. Anderson is from a paper he and Dr. G. T. Clayton published in February, 1972, in the *Arkansas Alumnus* entitled "Something 'New' for Science Students." Amazingly enough, much of this 'new' idea they developed then is again being proposed 'anew' in an invited editorial in the *American Physical Society Forum on Education* (See *American Journal of Physics*, Volume 62, No. 5, May 1994, p. 395.) The AJP article, after analyzing the need for rethinking the present system of training graduate students in physics, continues, "Second, we need to undertake a similar analysis of the undergraduate physics curriculum. In addition to updating the physics major to meet market needs, we need to contemplate making a physics major an acceptable undergraduate preparation for medicine, business or law. . ."

Hurray for them, but that is exactly what we were doing in a big way at Arkansas in the 1970's. And (now some of my personal background and loyalty will come through), that is exactly what many of the small liberal arts colleges were doing when everyone thought they should "shape up" and turn out better trained students for the physics graduate schools.

Let us hear from Dr. Anderson and Dr. Clayton and the Arkansas Alumnus article of February 1972.

"Briefly, here's what makes the new program appealing.

"The University requires that each bachelor of arts candidate successfully complete 124 credit hours of study. Of these, approximately forty-two hours are general education requirements of the University and the College of Arts and Sciences. The remaining courses constitute electives which may be chosen to satisfy departmental major or professional school entrance requirements. The B.A. physics program is designed to give the student the widest possible choice of these elective courses while still developing the basic skills of physics and mathematics.

"To obtain this degree with a major in physics, the student is required to satisfactorily complete twenty-four credit hours of physics, sixteen credit hours of mathematics, and nine credit hours of advanced level courses in what is termed a "special emphasis study area." This

total of forty-nine credit hours still allows the prospective B.A. candidate a minimum of thirty-three hours to pursue studies in still other fields of interest, satisfy the entrance requirements of professional schools, or obtain a secondary school teaching certificate.

"The prospective B.A. major is expected to satisfactorily complete courses in trigonometry, calculus I and II, and either calculus III or statistics. The level of mathematical proficiency achieved by the student who successfully completes these courses will be high enough to encourage his or her use of mathematics in the solution of various practical problems.

"Twenty-four hours of physics are required of the student including courses in introductory physics, electromagnetic fields, circuits and devices, physical mechanics, atomic and nuclear physics laboratory, electronics, computer logic, and modern optics. The emphasis in these courses is "learning and doing." All present the student with extensive laboratory experience so that he can become readily familiar with the tools and devices of a modern technological society. These physics courses were chosen and are designed to provide the student with a sound background in physics which will be useful to him irrespective of his eventual career choice.

"The final part of the program consists of nine credit hours of junior and senior level course work in a "special emphasis study area." This is the unique and most appealing aspect of the Physics Department's program. It encourages the student to broaden his studies and to enter a career field consistent with his interests and abilities.

"At present there are more than twenty different approved special emphasis areas. Each of these disciplines has been specifically selected because they are either quantitative or at least semi-quantitative in nature. We believe that a young man or woman working in these areas and possessing additional quantitative training in mathematics and physics above that nominally possessed by a worker in the field could be expected to contribute to the advancement of the field.

"Some of the special emphasis areas are agriculture, anthropology, astronomy, audiology, biological sciences, business, chemistry, communications, computer mathematics, electronics, entomology, environmental sciences, geography, geology, management science, mathematics, physics, psychology, sociology, and teacher preparation.

"The new physics B.A. program is indeed a "student centered" program. The student is given the widest possible choice of career options and encouraged to use his elective hours to take additional courses (in addition to the nine hours required) in the emphasis area which is most appealing to him. The student is continually encouraged by the Department's faculty to enter a career in which he can be both happy and productive.

"Many outstanding career opportunities still exist for students who adequately prepare themselves during their college careers. However, we believe that it is the broadly trained science student who can best fill the widely divergent needs of an ever increasing technological society. "

Again, in 1994-95, almost as if history repeats itself, the department is desperately seeking to find a broader base of service to "fill in the gap" produced by the poor job market for the truly professionally trained Ph.D. physicist!

C. B. Richardson in the Modern Physics teaching laboratory.

As pointed out above with the quote from the *American Journal of Physics* (Volume 62, No. 5, May 1994, p. 395) in a Guest Comment article

entitled "Why the APS must concern itself with education", the physics community is questioning again some of its own highly specialized judgments and ideas of programs.

The falling off of enrollments in physics during the 1980's and 1990's was no local problem, but some of the members of the physics department at Arkansas felt that the B.A. program might have continued with reasonable success if someone had been willing to continue as its active proponent. The development and continuation of this program had required considerable time on the part of Dr. R. J. Anderson and other members of the department, even over and above merely teaching the special courses, and the demand to develop a more recognized graduate program placed great stress on the always only marginally staffed department. Successful education programs always seem to be "very labor intensive," to use a relatively popular term these days, and pressures for success in their own professional activities seem to compete with these ideas far too often. But for some of us who especially liked working with the undergraduate physics majors, the 1970's was also a time when we went to "Mount Olympus"!

Advanced Laboratories

All of the physics course listings from 1928 and even earlier and up into the 1950's show a very interesting advanced laboratory course of variable credit. Students could enroll for one or two credit hours in any semester with a limit of four to six hours total during the undergraduate course. Parsons, Ham and Roberds taught the course in different years. It was still being elected by a few physics and engineering students in the 1940's and 1950's

The advanced laboratories listed in the 1969-70 bulletin referred to above are electronics and modern physics. One interesting entry is an independent study course for honors students. It was very active at that time. An x-ray laboratory active during the 1940's and 1950's had been canceled but a laser optics teaching laboratory was to develop soon

1981-82 Catalog

This catalog lists fourteen physics faculty members and a total of approximately 60 courses, exclusive of elementary laboratories, and exclusive of special courses for teachers. Many of the courses are taught only in alternate years or on demand but they cover a broad range of physics. The classical areas are well represented, including also mathematical physics and methods courses. A course in physical mechanics is offered for the B.A. students and students from other departments. Quantum mechanics, relativity, and various courses relative to atomic and nuclear and fundamental particle physics appear there. Most notable since the 1969-70 listing are the relatively newer courses in laser optics and quantum optics. Also there is a new course in plasma physics. There is a new course in advanced quantum theory. Interesting courses in physics for architects and physics and human affairs stand out as relatively new.

The x-ray diffraction course has been dropped but an optics course for teachers and a reactor physics course have been added. A timely course in energy and society had been introduced in the early 1970's.

The period between 1970 and the 1981-82 catalog seems to have been very active in course development, even if degree production is down from the last decade!

The astronomy course listing has increased from one course in 1967 to three in 1969-70 and twelve courses in 1981-82. Selected astronomy courses can be used to help fulfill the requirements for a physics degree.

The B.S. degree program still requires thirty-six credit-hours but the B.A. program has dropped from thirty to twenty-four hours. The total hours required for the B.A. is still 124 but the B.S. requirement has dropped from 136 to 132!

A minor in physics is defined.

1995-96 Catalog

This catalog lists eighteen (including Donald Pederson, vice chancellor for academic affairs) physics faculty members. The course offering now numbers approximately 60 courses exclusive of introductory laboratories! Again many of these courses are listed as on demand or in alternate years. Mathematical physics and methods

course was made a two-semester course.

The B.S. degree program requires 38 credit-hours of physics and the B.A. program is still 26 semester hours. Each program requires total hours of 132 and 124 respectively.

The general physical science course is now a one-semester four-credit-hour course. Also included in the physical science listing is a course titled Physical Science for Elementary Teachers and a course titled Higher Order Thinking in Science

A two-semester course for architects is shown.

The few courses in computer science taught in the mathematics department starting in the 1960's have exploded to over 40 courses now offered in a separate Computer Science Department. There is also a Computer Systems Engineering Department in the College of Engineering. The College of Business Administration has a Department of Computer Information Systems and Quantitative Analysis.

Almost all of the departments of the University make some use of computers or microcomputers at least as word processors and for library search.

Honors Program

The following excerpts are from a communication from Dr. Harold Hantz, former head of the Honors Program of the College, dated February 15, 1993. Considerable information about the program is communicated and a little of the wonderful spirit of teaching that was displayed then is evident.

Dear Paul,

"Enclosed is a copy of the history of the Honors Program, 1954-1974.- - - - -

"I enclose also the Physics Honors graduates 1955-1975.- - - - -

A history of the Honors Program, 1954-1974 by Harold D. Hantz,

(Emeritus Professor of Philosophy and Coordinator of Honors 1958-1974)

Introduction-

"Honors Programs have been a part of American higher education for more than a century; however, the development of such programs in public institutions was slow. After World War II the rapid increase in enrollment was concentrated in public colleges and universities. These institutions struggled to educate the flood of students of widely differing abilities. Perhaps correctly they first provided remedial courses for the inadequately prepared, but before long it became clear that the talented were the forgotten student.

"The University of Arkansas was no exception. Accordingly, in the fall of1954 Dr. G. D. Nichols, Dean of the College of Arts and Sciences, appointed a committee to determine what might be done for superior students. After five months of study the committee recommended an honors program with the general objectives of providing superior students with "...opportunities for additional and independent study, to broaden and deepen both their own fields and their general educational backgrounds." (Regulations of the Honors Program, I.)- - - - -

"The administration of the program was placed in an Honors Council, whose first duties consisted in the implementation of the junior-senior departmental independent study and research program. New developments were quick to follow. - - - -

"In 1960 the Special High School Program was inaugurated. Thus by 1960 the basic structure of the Honors Program was established.- - - - -

"As the program grew, a half-time Coordinator was appointed in 1958.- - - - -

"In 1969, at the request of the Honors Council, the faculty added three student positions to the council.- - - - -

The Junior-Senior Independent Study and Research Program.

"This aspect was originally, and remained, the foundation of the Honors Program.- - - - -

"Another device to deal with standards within and among departments was outside examiners. Each candidate had an honors committee consisting of an adviser and a second member of the department as well as two outside examiners, a member from a related department and a member of the Honors Council.- - - - -

"The committee structure worked well. Honors Council members became acquainted with a variety of programs and developed a sense of standards concerning several departments.- - - - -

"It is noteworthy that the natural sciences provided the largest number of awards and the highest percentage. The program always had strong support from the natural sciences—something that could not be said in every program over the country.

"More specifically what did the graduates do? It is impossible to review the work of 299 students, but a few examples are worth noting. There was the student in botany who began his research as a junior and had seven papers published or in press by the time he was graduated. There were honors papers published in the Journal of Inorganic and Nuclear Chemistry, the Physical Review, and the Review of Scientific Instruments.- - - - -

"From 1960 to 1973, 474 students earned 2,982 hours of college credit with a combined grade point of 3.04, which is decidedly a above the average of regular students.- - - - -

"A study of the years 1962-1965 showed that of the 198 full-time faculty of the College, 55% had served as instructors of honors sections, advisers for independent study and research, instructors of colloquia, members of the Honors Council, or members of the honors committees evaluating students.- - - - -

"Not only were many faculty and students committed to the program but so were Dean Nichols, Dean Kruh, and Dean Anderson, who provided every possible support, often in budgetary depressed periods. It is very easy for a Dean to say, "Why teach 15 students in Honors Western Civilization when they can be absorbed in the other regular sections?" But they did not. They were consistently generous in supporting small sections and the other aspects of the program.- - - - -

"In the Council's conferences with instructors of honors sections, one excellent instructor said, "I enjoyed teaching my honors section, but it took too much time from my research."- - - - -

Dr. Harold D. Hantz, February 1993.

The following is quoted from a letter from Dr. Richard J. Anderson (honors director, 1983-89) dated January 1993.

HONORS STUDIES- "Since its inception in 1955, the physics faculty has been strong supporters of Honors Studies within the College of Arts and Sciences. They have acted as honors research advisors, served on honors examination committees, taught honors classes, or served on the College Honors Advisory Council. Throughout the years students also have played an important role in the development of the program. Over the period 1957 through spring commencement 1993 over sixty students have received their baccalaureate degrees in physics "with honors." The awarding of physics department honors was based primarily upon of the completion of an honors thesis and its defense in an oral examination administered by a faculty committee. Some students enrolled in special sections of regular classes that were designated honors classes (e. g., Western Civilization, English, etc.). During the 1960's the physics department also offered a special honors section of the introductory calculus-based physics course. The enrollment pressures plus budget constraints forced termination of the honors section until once again in the 1980's Dr. Anderson revived the practice.

"Honors students in physics were recognized on campus as being well trained in their discipline and creative in their honors research projects. For most students the honors research project involved working with faculty and their graduate students on an ongoing research project. It was not unusual for honors students to receive recognition of their work by being named as a co-author of a physics journal publication or meeting presentation. Some students, however, embarked upon special honors projects of their own design. For example, Jonathan Siegel designed an honors optics experiment dealing with the photo sensitivity of the eye and its capability to detect a "single"photon. Upon graduation Jon went on to receive a medical degree and served for a time on the faculty of Northwestern University. Students who were most successful in pursuing their honors research and who demonstrated outstanding achievement received their degrees with "high honors." Throughout the period 1960-75 the Physics Department was a leader within the College in the production of honors degrees." Dr. Richard Anderson, January 1993.

Content and Purpose

The five "snap shots" of the physics catalog

listings (1928, 1945, 1969, and 1995) and the 1960 B.S. course listing have been presented above. These coupled with the discussions reflect the way physics has grown both locally and as an academic field of endeavor.

The subject matter has developed from almost pure classical studies in 1928 to a program strongly based in modern physics by 1995. Mathematical and theoretical physics, including quantum mechanics and relativity theory, are well represented. There are courses in atomic and nuclear physics, solid state and modern optics. The major thrust within the department at the present moment relates to lasers and quantum optics.

It is also interesting to note the growth of the physics faculty from three in 1928 to twelve in 1969 and eighteen in 1995. During this same time the University enrollment has increased from approximately 1,500 students to over 15,000. We are still a small University in a small State, but not negligible! The enrollment in the introductory physics courses has grown from a few hundred per semester in 1928 to 850 in 1993. There are approximately 100 students per semester enrolled in astronomy. Other degree production information is in Chapter 10.

One hundred years ago the books looked like philosophy books. Physics was natural philosophy with mathematics, the "queen of the sciences", becoming more and more a recognized part of physics. Then in the earlier decades of this century the books started placing emphasis on applications. Physics was proving itself to be useful! Examples of inventions and devices that might be seen in the environment were much in evidence.

Then in the middle of the century a big new push came to place more emphasis on teaching physics principles without so much thought about applications. Pictures of equipment and discussion of applications were mostly eliminated. This added emphasis on "fundamental principles" was especially prevalent in the sophomore courses for science and engineering majors. The general physics texts studied primarily by medical and biological science majors might still have examples of applications taken primarily from the medical and biological field.

A list of the authors of textbooks used in the beginning courses throughout the years brings back memories. Some of those recalled are Beiser, Eldridge, Stewart, Freeman, Giancole, Resnick and Halliday, Robson, Rogers, Sears and Zemansky, Shortley and Williams, Tipler, and White. At even earlier times names like Dull,