1983

Physics

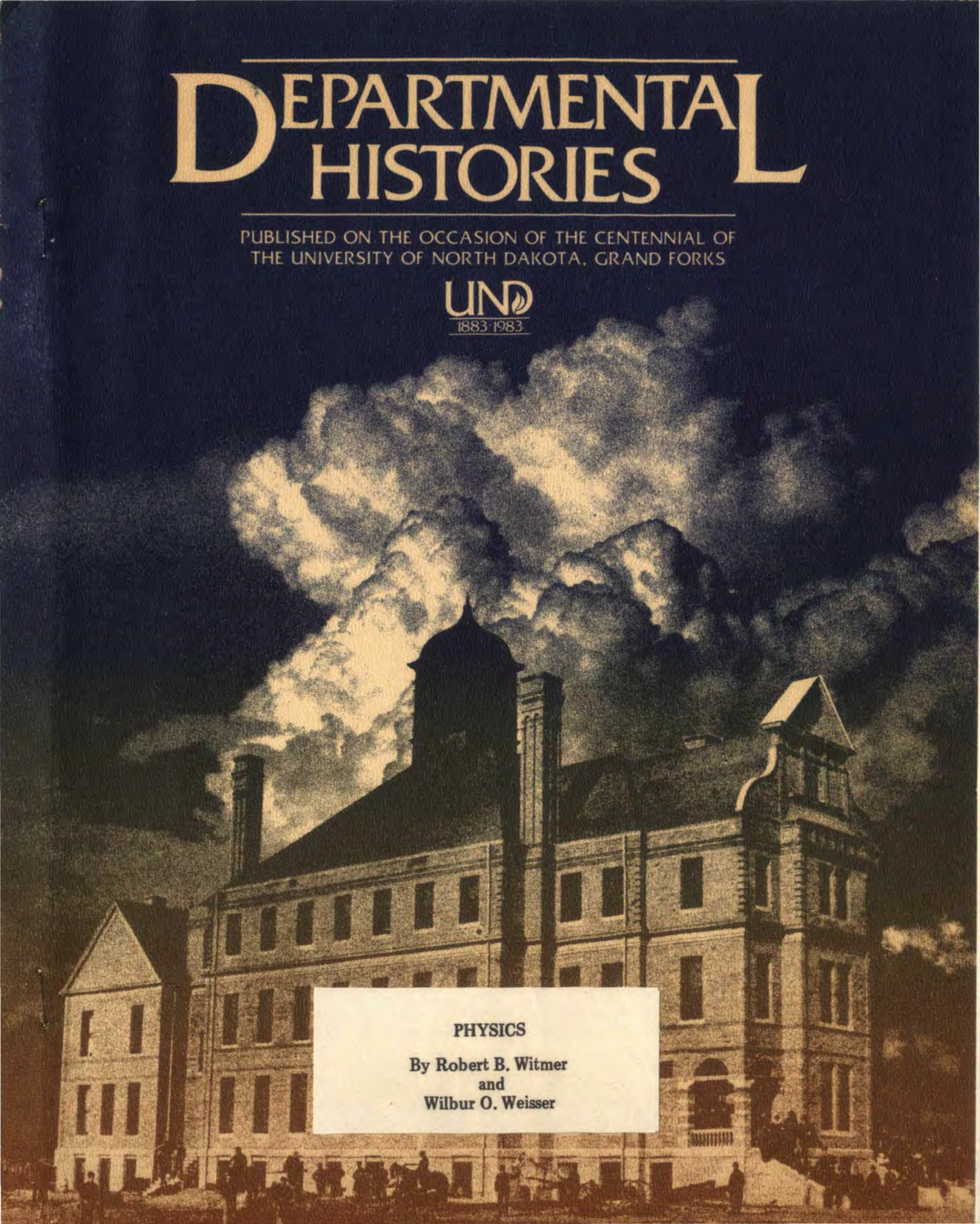
Robert B. Witmer
University of North Dakota

Wilbur O. Weisser
University of North Dakota

DEPARTMENTAL HISTORIES

PUBLISHED ON THE OCCASION OF THE CENTENNIAL OF
THE UNIVERSITY OF NORTH DAKOTA, GRAND FORKS

UND
1883·1983



PHYSICS

By Robert B. Witmer
and
Wilbur O. Weisser

THE DEPARTMENT OF PHYSICS
UNIVERSITY OF NORTH DAKOTA

1883-1970

By Professor Robert B. Witmer

A History update, 1970 to the present

By Professor Wilbur O. Weisser

INTRODUCTION

While short histories of several colleges of the University of North Dakota have been written, apparently only one department (Geology, 1954) has prepared its history. It seemed that some record should be compiled for the Department of Physics while pertinent information was still available.

The following brings together facts regarding the University of North Dakota's Department of Physics relating to personnel, enrollments and growth, budgets, and achievements which may serve as milestones in viewing the development of the Department during the eighty-seven years of its existence (1883-1970).

The frequent references to the difficulties and handicaps encountered and overcome through the years should not be construed as being unique with the Department of Physics, rather that they were signs of the times, and represent the problems which confronted all of the science departments, and in some cases the entire University.

The writer is indebted to the staff of the North Dakota Room of the Chester Fritz Library for its patience and help, to the University Business Office for making available payrolls of former years and to the Purchasing Office for its assistance in verifying certain inventories. Sincere gratitude goes to Miss Myrtle Pedersen, Associate Professor of English at the University of North Dakota, for reading and checking the manuscript.

ROBERT B. WITMER

THE DEPARTMENT OF PHYSICS
UNIVERSITY OF NORTH DAKOTA
1883-1970

The program in physics at the University of North Dakota dates from the founding of the University (1883) when a Department of Mathematics, Physics and Astronomy was established under the chairmanship of Horace B. Woodworth who was the sole instructor in the combined Department. The Department then is among the oldest at the University.

At the time, some five years before statehood, with only one four-year high school in North Dakota, the original enrollment was entirely in the "Preparatory Department", that is, not in a regular college-level program. Professor Woodworth, with a B.A. from Dartmouth and a diploma from Hartford Theological Seminary, was neither a mathematician nor a physicist, but he willingly did his best.

The first offerings in physics consisted of Chemical Physics-Heat, primarily for those in the Preparatory Department and an elementary one-year course also at the preparatory level. The course was largely descriptive with very little laboratory work, covering the topics of heat, sound, and light to be followed by mechanics, sound, and light (continued) and electricity and magnetism. In addition, a course in Plane Astronomy was offered under physics.

It would seem evident that with the above mentioned courses, plus algebra, plane geometry, and solid geometry, even though distributed over several semesters, being taught by one man, none of the work could be very rigorous. It should be remembered also that, at the time, Main(1), the only building on the campus, contained living quarters for the President and his family, living quarters and dining room for the students, all the offices and classrooms as well as the chapel, library, and museum. Little wonder, then, that there was space for only one small laboratory to be shared by the sciences. Science equipment, too, was very limited. The legislative appropriation for this purpose for all the sciences had apparently been $1000. In the summer of 1885 about $400 worth of equipment was added.

This was apparently the situation until 1887 when Professor Woodworth transferred to other areas (history) and Dr. Ludvic Estes came to the University as chairman of the combined Department of Mathematics, Physics and Astronomy. Dr. Estes had received his Ph.D. degree from the University of Michigan and had served as instructor there. He was well trained in science and had the reputation of being a thorough teacher. With the completion of Davis Hall (1899) space for a separate laboratory for physics became available in Main, and Dr. Estes immediately began a modest but systematically planned laboratory.

---

(1) The original building was known as "Main" until 1912 when it was renamed Merrifield Hall. In 1930, when New Merrifield was dedicated, the original building became known as "Old Main".

For some five or six years there seems to have been little change in the listed offerings of the Department, though the program, now in the hands of a trained physicist, was strengthened, topics added, and laboratory and experimental approach developed. The University catalog for the academic year 1892-1893 states that the course was "substantially the same as that required for admission to Harvard University," that is, still at the preparatory level.

The first record of a college course in physics appeared in the University catalog for the academic year 1893-1894 as course I (a) Laboratory work in mechanics and heat, (b) Laboratory work in magnetism and electricity, and (c) Laboratory work in sound and light. Apparently each of the above studies was for one term and combined to constitute a one-year course. In addition, a one-term course II Light and Electricity was added and the astronomy program was expanded to include a course in Practical Astronomy.

Additional expansions of the offerings were made in 1895 by the addition of a course III Advanced Physics Investigation and a third course in Astronomy.

Dr. Estes, through the Department, in 1890 established the first weather reporting station at the University.

Following the death of Dr. Estes (March 1898), Mr. C. J. Rollefson came as departmental chairman. Although he did not have his doctor's degree at the time, he had had graduate training at the University of Minnesota and at Cornell. In addition to his departmental responsibilities Mr. Rollefson, in 1898, was listed as being "in charge" of the work in Scandinavian Language, a program required by law. This assignment may have involved the teaching of several courses.

In 1899 Elwyn F. Chandler, a brilliant mathematician with his M.A. degree from Ripon College, joined the staff as instructor in Mathematics. In 1901 the Departments were separated with Mr. Chandler as chairman of Mathematics and Mr. Rollefson as chairman of the Department of Physics and Astronomy.

An increasing proportion of college students was enrolling and the advent of programs in engineering now operating to a minor degree placed pressure on the Department of Physics to supply some service courses of a practical or applied nature. To meet this demand, "partial" courses in Dynamo Laboratory required of electrical, mechanical and mining engineers were added.

Prior to this time (1898) it might seem that the sciences were considered as "second-class citizens" in the overall university program. All of the sciences were being taught by three men, Melvin A. Brannon, biology; Earle J. Babcock, chemistry and geology; and C. J. Rollefson, physics and astronomy. Able as these men were, they each had additional responsibilities in other areas. Contributing to the situation were the difficulty in obtaining trained personnel and the scarcity of funds needed for expensive laboratory equipment. The University catalog of 1898 indicated that the equipment was adequate for

elementary courses, not too unlike the statement in 1893 regarding "admission to Harvard." Contributing also to the apparent lack of interest in the sciences was the emphasis and the support by the administration of certain other disciplines in emulation of the classical programs of the eastern colleges. The status of the sciences had, however, been changing. The coming to the campus of Homer B. Sprague as President in 1887 resulted in a broader view of education. Despite his great interest in the humanities he immediately began the appointment of specialists (Estes) in the sciences. Growing demands to supply practical information valuable to the development of the State was evidence of recognition of the usefulness of the sciences. The discontinuance of the B.S. degree (1894)(2) and the acceptance of the sciences into the Bachelor of Arts program was admission that exposure to them could contribute to a liberal education, the objective of the Liberal Arts curriculum.

In the summer of 1902 Science Hall (Old Science) was completed. The building, four stories--50 x 100 feet--was, according to the bid by the Dinnie Brothers, to cost $31,587 with certain allowances depending on the type of plaster used. The building absorbed all of the sciences from Main. The basement was occupied by mining engineering and geology, the first floor by physics, the second floor by chemistry and the third floor by biology and the University museum.

Mr. Rollefson, who resigned in 1903 to study medicine, was succeeded as chairman of the Department by George W. Stewart who held a Ph.D. degree from Cornell University. In addition, Jens M. Rysgaard, though the Departments were now separate, shared his time as instructor with Mathematics and Physics.

The University catalog of 1904 indicates that the course offerings in physics consisted of the three-term Preparatory Course: course I, the three-term course in General Physics; course II, two terms of Electricity and Magnetism and a third term of Applied Electricity; and courses III, IV and V, each a one-term course in heat, light and electricity and magnetism, respectively. Astronomy had disappeared from the offerings to reappear in 1911 under Mr. Chandler, independent of either mathematics or physics.

Dr. Stewart, well trained, energetic, and enthusiastic, had a special interest in thorough teaching and in the presenting of subject matter with the aid of striking demonstrations. Apparatus for demonstrations or laboratory was very limited, and much of what was available was constructed in the Department. Mr. Rollefson's report to the Board of Trustees for the academic year 1903-1904 had indicated that, while the laboratory was fairly well equipped for the Preparatory Course, course I was poorly provided for and course II had practically no equipment and that all courses were in need of lecture apparatus.

---

(2) The B.S. degree was revived in 1913.

His report further estimated the departmental inventory at about $3700 and stated that "the University Library does not contain any books or periodicals which would enable a student to learn what is known today on any subject in physics."

Dr. Stewart's report for the following academic year (1904-1905) again bemoaned the absence of library materials and pointed out that an annual departmental appropriation of $500 was inadequate since only about half the amount was available for equipment and library. In the academic year 1906-1907 the Department received an allowance for the library of $30 which was "sweetened" by $30 from the $500 appropriation.

In spite of inadequacies, such as the above, progress was made, courses were strengthened, and, by enrolling students in semesters of different courses, an attempt was made to meet the needs of students in pre-medicine, engineering and those going into teaching.

In 1906 a one-semester course, Teaching Physics, was added to the departmental offerings.

While at North Dakota Dr. Stewart did some publishing. His first articles were related to the design of laboratory and lecture equipment and to courses in physics for secondary schools. Later his publications were on research carried on for the State Oil Inspector.

In line with his interest in science teaching Dr. Stewart, in 1907, was responsible for the organizing of the North Dakota Association of Science and Mathematics teachers, the function of which was to encourage and guide the high schools in their programs in mathematics and science.

Through the years, with an increase in the number of four-year high schools in the state, the proportion of college students enrolling had increased while the number in the preparatory program was leveling off. In the academic year 1907-1908 the enrollment in the Department of Physics was, by "terms," Preparatory 58, 61 and 53; College 36, 36 and 35.

Legislation of 1907(3) eliminating the enrollment of sub-college students in the University, brought about a shift from Preparatory to Model High School but did not greatly change the number in the sub-college program. Not until the academic year 1908-1909 did the enrollment in the Department of Physics include more college than Model High School students, by semesters(4) Model High School 50 and 46; college 61 and 56. The University catalog for that same year listed the offerings of the Department of Physics as thirty-eight semester hours distributed over fourteen semesters of work.

---

(3) The preparatory program was no longer listed in the University catalog for the academic year 1906-1907.

(4) A change from the three-term to the semester system was made in 1907.

Dr. Stewart left the University of North Dakota in 1909 to assume the chairmanship of the Department of Physics at the University of Iowa, a position he held until his retirement in 1942. For many years he conducted widely attended colloquia on the teaching of physics, and in 1942 he was given national recognition for his many contributions to physics teaching when he was awarded the Oersted medal by the American Association of Physics Teachers, an award given annually to an outstanding teacher of physics.

The coming of Dr. Stewart plus the occupance of Science Hall might be considered as giving physics at the University of North Dakota a fresh start; but the coming of his successor, A. Hoyt Taylor, in 1909, certainly marks the beginning of the most colorful period for the Department.

The thirty-year-old Dr. Taylor, with degrees from Northwestern and the University of Michigan and the doctorate from Gottingen, had had teaching experience at the University of Michigan and the University of Wisconsin. He brought with him Dr. B. J. Spence, a graduate of Northwestern who had earned the doctorate from Princeton. In 1910 Dr. E. B. Stephenson, with his doctorate from the University of Illinois, replaced Mr. Rysgaard, who resigned to assume a position at Hamline University. For the first time the Department had a staff which in preparation and size was commensurate with the offerings.

Influenced by demand, the specialities of the staff and, to a large extent, his own field of interest, Dr. Taylor in 1909-1910 brought about a rather complete organization of the Department. In the process, courses dropped included Teaching Physics,(5) a year of General Physics, the second year of Light, Heat etc., Experimental Physics, and Applied Electricity. In their place courses in Engineering Physics, Mathematical Physics, two courses in Alternating Currents, Physics of Music, and Individual Research were added, to be followed later by High Temperature Measurements, Photography, and Colloquium. This resulted in a reduction in the offerings from 46 to 34 semester hours.

The annual report for the academic year 1910-1911 states that "the courses for engineers and arts and medical students have been sharply differentiated," that the "time for all elementary laboratories has been doubled," and that "Each instructor in the department teaches about 15 semester hours exclusive of preparation for lectures and laboratory."

The departmental inventory for 1910 shows $8400 including furniture.

The staff, young, energetic and able, became active not only in their profession but also on and off the campus. Some five or six papers were published each year, and one experiment and publication on the Storage and Utilization of Wind Power attracted enough attention to receive $1000 support from the legislature, a support which was vetoed by the governor. Taylor and Spence were used extensively on University committees, and all three were active in The North Dakota Mathematics and Physics Association, North Dakota Education Association

---

(5) Physics for Teachers was apparently reinstated prior to 1918.

and two, at least, in such town and gown organizations as Fortnightly and Franklin Club.

This was the beginning of the Era of Progress and Poverty (1910-1920) referred to by Louis Geiger in The University of the Northern Plains. Enrollments in the Department were increasing rapidly, especially in the advanced courses. Graduate assistants appeared, and some relatively costly pieces of equipment were obtained.

Dr. Taylor's particular interest was in radio, then in the embryonic stage. He had done some research in the field at the University of Wisconsin and proceeded at once to add courses in radio communication and to establish a station. By 1910 he had set up one of the early radio stations in the country, first operating unlicensed under the call letters UND and later licensed under 9YN.

While both Dr. Spence and Dr. Stephenson were active in research and publication, it was the work of Dr. Taylor which attracted a great deal of attention not only within the State but on the national and even the international level.

Fully cognizant of the importance of radio Dr. Taylor went to great lengths to bring it to the attention of the public. Through the University Extension Service he gave numerous lectures on radio telegraphy with demonstrations and was responsible for a rapid growth in the number of amateur stations in the State (10 in 1912 to 40 or more in 1915). His cooperative research with the Universities of Wisconsin, Michigan, Washington at St. Louis, and Colorado drew nationwide attention.

In 1913, by authorization of the federal government, weather reports from Chicago telegraphed to the University were re-broadcast along with time to some sixteen towns in the State. This was later expanded to include stations in Minnesota and South Dakota.

Taylor's continued close association with Earl Terry and group, former colleagues at the University of Wisconsin, greatly strengthened his own work and, in addition, provided an outlet for his students. It was through the influence of Dr. Taylor that such men as Raymond Heising continued graduate work at the University of Wisconsin and B. J. Johnson and Harry Nyquist at Yale and that they, Arthur Kishpaugh, and others eventually entered the field of research and were themselves tremendously productive.(6)

By 1913 Dr. Taylor's research and publications had been extended into the area of radio telephony and, though suitable equipment was very limited, the station became involved in the transmission of voice and music. Here again Dr. Taylor, a showman and "riding a winner," attracted considerable attention.

---

(6) By 1951 Raymond Heising had 131 patents to his credit, all basic to the development of radio and radar.

In 1916 the Department, now with an enrollment exceeding one hundred, had an inventory of $12,209 (including furniture and supplies), a shop inventory of $899, and an annual budget of $1000 plus $100 for the radio station.

In 1917 the Department was badly crippled and experimental work discontinued by the approaching national emergency. On the first of April Dr. Taylor, with a commission in the Reserve, left the University on leave for the Great Lakes Naval Training Station. On the fifteenth of May Dr. Stephenson entered officers training at Fort Snelling. The course commitments of the Department were carried to completion by Dr. Spence with the aid of advanced students Messrs. Sandvik and Carlson and a Mr. Crossley (mechanician) who handled the courses in radio.

During World War I Dr. Taylor served successively as Superintendent of Communications of the ninth, tenth and eleventh naval districts, and as Superintendent of Trans-Atlantic Communications and Officer in Charge of the Experimental Radio Division at Hampton Roads. After the war he assumed direction of the Naval Aircraft Laboratory and later, until his retirement, served as Superintendent of the Naval Research Laboratory.(7)

With the coming of war the University programs were drastically adjusted to accommodate to the situation. Vocational programs appeared, and only those courses in the fields of English, mathematics, the languages, physics, chemistry, American history, engineering and medicine which were deemed to have a bearing on the training of officers were taught. With the establishment in 1918 of the Student Army Training Corps (S.A.T.C.) the campus was basically an army camp and the few regular students had to adjust their programs to courses offered. An influenza epidemic brought about a quarantine, and students not in the military were sent home in October while S.A.T.C. classes continued until Christmas. When classes resumed in January, additional adjustments had to be made to accommodate those who had been regular students and those in S.A.T.C. The net result might be considered somewhat unsatisfactory.

The work of the academic year 1918-1919, largely devoted to recovery, was handled by Dr. Spence and W. R. Brackett with the aid of two student assistants, Pearl Young and Verna Stumpf. The following year W. H. Bair replaced Mr. Brackett and Miss Young joined the staff as instructor.

Returning veterans and a doubling of the class of pre-medical students thrown off schedule during the war swelled the enrollment in the Department, an enrollment reported that year as "unprecedented."

---

(7) For a brief summary of Dr. Taylor's work at the University of North Dakota see the Naval Research Laboratory Report, Chapter V, UND 1909-1918 in the North Dakota room--Chester Fritz Library. Dr. Taylor died in December 1961 at Claremont, California.

With the departure of Taylor and Stephenson the research and experimentation in radio practically ended. The Department requested a special allocation of $50 a year to reinstate the broadcasting of time and weather. This apparently was not approved and the equipment was gradually dismantled.

The space situation in Old Science had become critical. As many as 93 students were crowding into a lecture room designed for 60 and 20 or more into laboratories designed for 16. The completion of Mechanic Arts (later Chandler Hall) in 1902 had not helped, as Mining Engineering and Geology did not move until the opening of Babcock Hall in 1908. Nor did the completion of the Chemistry Building (later Biology) in 1919 help physics appreciably because of the needs of the expanding Medical School and Public Health Laboratory. Heating and ventilation were poor, lecture rooms and laboratories could not be darkened for experimental work or demonstration, and the lack of space for specific purposes required much shifting of apparatus, all of which contributed to inefficient operation.

Dr. Spence left the University in 1920 to assume the chairmanship of the Physics Department at Northwestern University. He was followed by Dr. Karl H. Fussler, a graduate of the University of Indiana, having his doctorate from the University of Pennsylvania. Just before the opening of the University in the fall, Mr. Bair resigned, leaving Dr. Fussler and Miss Pearl Young as the entire full-time staff. Replacements were not available for the two senior student assistants usually employed. Temporary relief until the later part of November was supplied by Mr. Franzo Crawford, an assistant, who at that time had to leave for Oxford University to pursue his studies as a Rhodes Scholar.

In spite of the shortage of staff apparently all required courses were offered, but for the next several years inability to offer elective courses had a damaging effect on the advanced student enrollment in the Department.

At the beginning of the second semester Mr. Dow from the University of Pennsylvania came to the Department to fill the assistant professorship vacated by Mr. Bair. Mr. Dow, who was not interested in students and whose chief interest was in research, found it difficult to adjust to the teaching, which at the time was the primary interest or function of the Department. He resigned in the spring to accept a research position at the Massachusetts Institute of Technology.

Substantial relief came to the Department in 1921 by the addition of Mr. C. W. Byers from Purdue University as assistant professor and Mr. John L. Hundley as instructor from the University of Missouri.

Dr. Fussler, red haired, aggressive, and himself a good teacher, encouraged those on his staff to present their subject matter with thoroughness and clarity and with emphasis on fundamental underlying principles. Those who did their early teaching under his leadership doubtless adopted a pattern which in later life marked them as "good teachers."

During the biennium 1920-1922 Dr. Fussler directed his efforts toward the improvement of the physical facilities of the Department. By careful planning and rearrangement the capacities of the elementary laboratories were increased, equipment relocated to increase the efficiency of its use, and a thorough system of instrument calibration, inventory, and cataloging of permanent equipment begun.

With a complete turnover of staff and with teaching loads averaging nineteen contact hours, little research was carried on. However, Dr. Fussler did continue investigations started at the University of Pennsylvania, and various papers were presented by staff members at professional meetings.

The report for the following biennium, 1922-1924, indicated considerable progress. While the teaching loads were extremely heavy (18 to 23 contact hours), some seven research problems were completed or nearing completion. The moving of the Department of Geology to the new Law Building made available five additional rooms for class and much needed laboratory space. Departmental enrollment showed an increase of 18% with an increase of 36% in advanced courses.

In June of 1924 Mr. Hundley left the University of North Dakota to continue study toward his doctorate at the University of Chicago. Mr. Hundley was replaced by Robert B. Witmer who for several years had been a graduate teaching assistant in the Department.

For the next several years conditions did not improve, in fact worsened. Since 1923 the departmental enrollment had increased (by 1928) by 27%, yet the full-time teaching staff had not been increased.(8) Average teaching loads were nearly twenty-seven contact hours per week with larger sections and more advanced students involved. The annual report for 1928 further points out that during a seven-year departmental growth of 48% the annual budget increase had been but 4%.

In spite of this practically impossible situation research was carried on by the staff(9) and papers presented at the North Dakota Academy and before Sigma Xi.

While the 1920's represented a period of growth and expansion, it was one fraught with financial difficulties for the University as a whole. The post-war boom was over, farm prices were down, farm bloc politics was in evidence, and conflict between faculty and administration was taking its toll. Salaries were at a standstill, and the obtaining of costly physics apparatus for advanced work or research was out of the question. However, largely due to the efforts of Dr. Fussler, the elementary laboratories were now well-equipped.

---

(8) Increase of one student assistant to one graduate assistant.

(9) Fussler--Problems in Humidity.
Byers (and Banks in Medicine)--Effects of X-rays on animals.
Witmer--Resistivity of North Dakota clays.

This decade was a period, too, of considerable faculty turnover. Many of those leaving were key men on the campus and scholars who later made names for themselves elsewhere. Some left by choice; some were dismissed under the guise of an economy measure. Among those leaving was Dr. Fussler (on leave 1928-1929) who, in 1929 accepted a professorship at the University of North Carolina.(10)

Mr. Byers served as acting chairman for the academic year 1928-1929.

Of the newcomers some stayed only temporarily; others were to remain and leave their lasting imprints on the University. Among the latter was John L. Hundley who, now with his doctorate from the University of Chicago and experience at Tulane University, returned to North Dakota in 1929 as Professor of Physics and chairman of the Department. Since he had served as instructor of physics for several years (1921-1924) under Dr. Fussler, he did have the advantage of knowing something of the University, the Department and the staff.

Teaching loads were still excessive.(11) The full-time staff had not been increased since 1910 when the departmental offerings were fewer and the enrollment was very much less with little of the work at the graduate level.

Dr. Hundley, quiet and unassuming, well-trained, efficient and a tireless worker, immediately assigned himself a twenty contact-hour teaching load. This, while not affecting the average, did reduce the maximum from the previous thirty to twenty-two hours.

Needless to say, such teaching responsibilities did not permit the devoting of time to research on the part of the staff. However, the direction of graduate student research continued and several projects were completed.

Dr. Hundley's report to the President for the academic year 1929-1930 indicated that the greatest need of the Department was for more staff, if only in the form of an additional graduate assistant, thus reducing the number of hours the full-time personnel were devoting to elementary courses and laboratory.

Immediate relief, however, was not forthcoming. Mr. Witmer, who had been continuing graduate study during the summers, was granted a sabbatical leave for the academic year 1931-1932 to further pursue his doctorate at the University of Michigan. To fill the vacancy Miss Myrtle Sands returned from high school teaching. Mr. J. Donald Henderson, a graduate assistant who later was to become a full-time staff member, proved to be of valuable assistance.

---

(10) Dr. Fussler retired from his North Carolina position in 1952 and moved to Hawaii, where he died October 23, 1954.

(11) Ranging from 19 to 30 contact hours with an average of 21.6.

The effects of the crash of 1929 had reached the University of North Dakota in full force by 1931. Tax receipts had dropped and funds, though appropriated, were not available. A drastic cut in the general budget was made and salaries which had been at a standstill for some five years were figured for the first half of the academic year 1932-1933 at ninety per cent of the rate for the preceding year. An initiated measure(12) further reduced the salaries by twenty-percent of the January 1932 rates but in effect set the maximum salary (other than the President's) at $1920 for the school year. The top salaried professor, then, in 1933 was receiving half the salary he received in 1922.

The total University appropriation for the academic year 1933-1935, cut to less than half of that for the previous biennium, among other items allowed nothing for equipment. However, an allowance of $510 for equipment and $212 for supplies does appear in the 1934 budget for the Department of Physics, apparently from local funds. Dr. Hundley's annual report for 1934 was very critical of the budgetary allocations, pointing out that it was "absurd to hope to employ satisfactory student help at fifteen or twenty cents an hour when untrained students were receiving more than twice this amount from relief funds(13) for work of such poor quality as to be of no value to the department." It was also pointed out that most of the allowance for equipment would have to be used for operating supplies, leaving nothing for much needed additions to the equipment.

While some salary increases were made ($200 to $500) for the year 1936, the equipment and supply allocation remained unchanged. As a result the departmental inventories show a steady decrease until 1940 ($32,495 in 1933 to $27,425 in 1940).(14)

On the brighter side, the advanced students were increasing in number and improving in quality, with ten doing graduate work and three completing the requirements for the master's degree. In spite of handicaps there was ample evidence that the work of the Department

---

(12) Summary of initiated measure approved November 8, 1932.

"All classifications--Salaries reduced 10% from opening of school to December 7, 1932, when new initiated salary measure goes into effect reducing all salaries 20% from amounts paid for January, 1932 and providing that a state employee can not receive more salary than a member of the board or commission that employs him."

The average salary for professors was $1914; associate professors $1804; assistant professors $1613; instructors $1322.

(13) This was the period of the NYA, WPA, FERA, CWA and the local Camp Depression, as well as the beginning of an appreciable program of student loans.

(14) See Department of Physics Equipment Inventories, Table 1, page 13.

was of high quality. In the national physics tests taken by the students, the arts-medical group placed at the national average while those in the course for engineers and physical science majors placed far above the national average. Also the University of Wisconsin and the University of Illinois, to which schools physics majors had transferred on graduate fellowships, reported that the students were found to be exceptionally well-grounded in the necessary fundamentals. The University of Wisconsin further stated that its Physics Department would gladly accept recommended physics majors from the University of North Dakota without question.

Table 1

DEPARTMENT OF PHYSICS
Equipment Inventories
1904-1968

Year	Value	Year	Value	Year	Value
1904	$ 3,700	1929	$28,704	1950	$
1906	4,600	1930	29,919	1951	73,453
1910	8,480	1931	30,956	1952	
1911	10,449	1932	32,749	1953	78,018
1912	11,134	1933	32,495	1954	
1913	11,910	1934	31,013	1955	85,944
1914	12,777	1935	29,902	1956	86,001
1915	13,236	1936	28,023	1957	90,820
1916	13,571	1937	27,968	1958	101,811
1917	14,645	1938	27,499	1959	117,780
1918		1939	27,745	1960	124,647
1919	17,013	1940	27,425	1961	142,364
1920	18,936	1941	28,056	1962	155,305
1921	19,348	1942	28,908	1963	166,390
1922	20,488	1943	29,760	1964	166,312
1923	21,213	1944	30,300	1965	166,348
1924	23,583	1945	33,171	1966	166,802
1925	24,467	1946	39,572	1967	189,580
1926	25,829	1947	40,038	1968	214,982
1927	26,681	1948	45,364		
1928	27,740	1949	57,707		

During the late 1930's the departmental enrollment seems to have been rather stable, but teaching loads remained extremely heavy. Although there had been minor increases in salaries, there had been no other increased budgetary support. Witmer, now with his doctorate, was devoting half of his time to his position of Freshman Advisor but was still carrying a "half-time" teaching load of fifteen contact hours. Dr. Hundley in addition to his administrative responsibilities was not only carrying a twenty-three contact hours teaching load but was spending endless hours during evenings and weekends doing glass blowing and the repairing of delicate instruments which the relatively unskilled shop mechanician was unable to do; incidentally, he was also doing much of his own secretarial work.

The early effects of World War II, first felt on the campus in 1940, did not at first reach the Department of Physics. In fact the annual report to the President for the academic year 1939-1940 showed a thirty per-cent increase in the enrollment in general physics (largely pre-medical) over that of 1937-1938, while the enrollment in the course for engineers and science majors was exactly the same.

While the effects of the 1940 Draft Law had not been extreme, immediately following Pearl Harbor the male enrollment on the campus rapidly dwindled. Prior to this time, however, the advent of war-related programs had transformed the campus into a military camp.

The Department of Physics was not involved with the first two of these programs(15) but did supply courses for a Signal Corps pre-science radio program.

Witmer, now Dean of the Junior Division and half-time teacher in the Department of Physics, left in the spring of 1941 to teach during the summer in a defense program for Pennsylvania State University and on May 1, 1942, again left for Naval Officers Training School in Chicago.(16)

Mr. Byers left the University in 1942 to assume a teaching position at Union College in Schenectady, New York.(17) This left Dr. Hundley with two young instructors, George Feinstein and Raymond Staley, Jr., to handle the somewhat reduced but irregular department responsibilities.

An extensive contribution to the war effort by the Department of Physics began when in March of 1943 the Army Air Corps established the 304th College Training Detachment on the campus. To prepare for the first complement of 750 trainees, Dr. Hundley not only had to reorganize his laboratories but had to recruit a staff of approximately twenty from other departments on the campus, departments not involved in programs, and from older high school teachers of physics in the State. Such a staff of "retreads," of course, required a great deal of teaching and help from Dr. Hundley; but apparently the program was well conducted. By the time it was closed in June of 1944, some 2500 students had completed the work.

In the spring of 1943 another program was established at the University. This was a one full-year professional program, the "Army Specialized Training Program" (ASTP), consisting of a rather heavy concentration in mathematics and physics along with fewer courses in English, Geography and Drawing. Many of the trainees were men who had had some college experience and were considered a select group.

---

(15) Engineering Defense (January 1941) and Army Air Corps glider pilots (July 1942).

(16) Later transferred to Iowa City and subsequently became head of the Mathematics-Physics Department at that Navy Pre-flight School.

(17) Mr. Byers died on March 19, 1965, at Hillsdale, Michigan.

Since Dr. Hundley and his staff were busy with the Air Corps program, it was necessary to set up an independent department and staff. Dr. Witmer obtained a release from the Navy, and in June of 1943 returned to the campus to organize and head such a department. Miss Myrtle Sands, who had served in the Department of Physics for several years, was called back from her position with the Bureau of Standards. To this nucleus was added some six or seven of the top men from engineering no longer otherwise involved in defense programs. This potentially strong staff needed only a thorough review in physics as the course progressed, and training sessions to this end were held three times weekly. Adequate laboratory equipment was supplied by the government. The net result was a program with lecture, recitation, and laboratory comparable in every respect to the standard engineering physics and one which was rated highly by the inspecting groups.

As was true for the University as a whole, the post-war impact was strongly felt by 1946. In the preceding several years, some significant acquisitions in physical equipment had been made, largely through government surplus, but no appreciable increases had been made in the equipment budget.

University salaries in the academic year 1945-1946 stood at exactly the same level as those just preceding the drastic cuts of 1933. Although modest increases were made for the academic year 1946-1947,(18) such salaries were still not competitive, especially in the field of physics where the supply of personnel was limited and the demand in other universities, government, and industry had increased markedly.

During the 1948-1950 biennium special equipment funds were made available and Dr. Hundley was enabled to set up and equip a laboratory for advanced work in several areas, including modern and nuclear physics. In addition, the x-ray laboratory was equipped with a modern unit and with adequate darkroom facilities, and the shop and glass-blowing laboratory facilities were greatly improved.

In the absence of a skilled full-time technician Dr. Hundley was still spending endless evenings and weekends on glass work and the repair of delicate instruments.

Growing pains and understaffing continued to haunt the Department. By 1950 the departmental enrollment had increased by 100% over that of 1946, yet the full-time teaching staff had been increased by but one instructor, Mr. William E. Thornton.

Numerous changes in personnel took place in the immediately ensuing years. Dr. Witmer, now Dean of the College of Science, Literature and Arts, withdrew from his half-time teaching to devote full time to administration. Mr. Victor Kaufman replaced Mr. Thornton as instructor, and Dr. Robert Wild from the University of Missouri joined

---

(18) Average salary increases: professors from $3690 to $4850; associate professors from $3040 to $3707; assistant professors from $2755 to $3323; instructors from $2258 to $2454.

the staff.(19) The latter addition made possible a needed strengthening of the offering in contemporary physics. Mr. Harold Bale, who had been a graduate teaching assistant in physics and a research assistant at the U.S. Bureau of Mines Lignite Laboratory, joined the staff as instructor.

In 1954 Mr. Kaufman left the Department for Purdue University and Mr. Bale for the University of Missouri, each to continue work for his doctorate. Replacements included Dr. Edwin A. Whalin and Dr. Van O. Nicolai as assistant professors, both from the University of Illinois, and Mr. Kenneth Hartt as instructor from the University of Iowa. These men, able and well-trained and fresh from graduate school, provided the stimulus in research, much of which during the war years and the periods of severe understaffing had to be foregone. An increase in the number of graduate teaching assistants and the rather complete remodeling of Old Science were perhaps additional factors making the resumption of research possible. In spite of rapid increases in enrollment (23.9% in 1954), much of which was in advanced and graduate work, Dr. Whalin, Dr. Nicolai, Mr. Hartt and Dr. Hundley himself became actively involved in research and publication. Some of Dr. Whalin's research was under a Research Corporation grant which, among other things, provided several valuable pieces of equipment.

For some years Mr. Henderson and Dr. Witmer had been active in the promotion of improved teaching of science and mathematics in high schools and in the organization of Science Fairs. Mr. Henderson continued his interest and activities in the National Science Teacher Association in which organization he held committee memberships, became a member of the Board of Directors, and was a consultant to the Board. During the summer of 1955 he attended an Institute for college teachers at Harvard University to be followed by attendance at a similar institute at the University of Wyoming in the summer of 1956. Each of the above was on a National Science Foundation scholarship.

Through the initiative of Mr. Henderson the University in 1957 applied for and received a $63,500 National Science Foundation grant for a Summer Institute for Teachers of Science and Mathematics. Since that date these Summer Institutes have been held each year with financial support of approximately $80,000 annually. In 1959, again through the efforts of Mr. Henderson, the University of North Dakota received support for an Academic Year Institute in the amount of $249,912.(20) These grants have been continued each year for a total support through 1970-71, of $3,755,931.

Mr. Henderson, a perfectionist, a tireless worker with definite ideas as to what the program should accomplish, conducted his institutes in a highly efficient and successful manner, so much so, in fact, that he soon received national attention.

---

(19) Dr. Wild left the Department in 1953 to assume the chairmanship of and organize a Department of Physics at the then new branch of the University of California at Riverside.

(20) See Science Institute grants, Table 2, page 17.

In the spring of 1957 Dr. Nicolai and Mr. Hartt resigned. Additions to the staff were Mr. Wilbur Weisser, Mr. Lyle Buckwitz and Mr. Gordon Lerfald. Mr. Weisser held a master's degree from the University of North Dakota and had had some eight years of successful teaching experience in high school and at Dickinson State College. Mr. Buckwitz and Mr. Lerfald, each with his master's degree, had served in the Department as graduate teaching assistants.

Enrollments continued to grow(21) and, while the Department was adequately staffed to handle elementary and intermediate work, there was a pressing need for men qualified to teach advanced and graduate courses and to direct research.

Table 2

NATIONAL SCIENCE FOUNDATION TEACHER INSTITUTE GRANTS

Summer 1957	$ 63,500.00
Summer 1958	65,000.00
Summer 1959	66,100.00
Academic Year Institute 1959-1960	249,912.00
Summer 1960	80,356.00
A.Y.I. 1960-1961	No Institute Held
Summer 1961	79,700.00
A.Y.I. 1961-1962	246,800.00
Summer 1962	80,600.00
A.Y.I. 1962-1963	254,300.00
Summer 1963	81,000.00
A.Y.I. 1963-1964	256,695.00
Summer 1964	82,100.00
A.Y.I. 1964-1965	257,100.00
Summer 1965	82,280.00
A.Y.I. 1965-1966	260,200.00
Summer 1966	83,210.00
A.Y.I. 1966-1967	261,800.00
Summer 1967	80,220.00
A.Y.I. 1967-1968	261,200.00
Summer 1968	80,060.00
A.Y.I. 1968-1969	240,700.00
Summer 1969	80,763.00
A.Y.I. 1969-1970	194,553.00
Summer 1970	80,819.00
A.Y.I. 1970-1971	186,963.00
TOTAL RECEIVED	$3,755,931.00

(21) 11.7% in 1955-1956; 18% in 1956-1957 and 19.2% in 1957-1958.

Some such help came in the fall of 1958 when Dr. Earl N. Mitchell joined the staff. Dr. Mitchell, with his doctorate from the University of Minnesota, had been for several years Director of Research with the Remington Rand Corporation of Minneapolis. His field of interest and specialization was in magnetic properties of thin films. Experienced and energetic, he immediately established his research program. In 1959 he obtained a National Science Foundation grant in support of his projects, the grant amounting to approximately $15,000 a year for four years. Mitchell's research activities not only opened another field of specialization in the Department and supplied appreciable financial support for three graduate students but, perhaps more important, was the additional stimulus for improvement in the atmosphere of investigation and research so necessary for a live, progressive staff.

Additional important changes took place in 1959. Mr. Henderson, now with his full-year Science Institute in operation, gave up his teaching in the departmental program to devote full time to teaching and administration in the Institute. Mr. Lerfald and Mr. Buckwitz, who had resigned in the spring, were replaced by Dr. Harold Bale, now with his degree from the University of Missouri, Mr. John Gjevre with his master's degree from Iowa State University, and Mr. James Cross who had been a graduate teaching assistant in the local Department.

While this exchange resulted in no increase in the number of full-time personnel, Dr. Bale's return further broadened and strengthened the departmental offerings in advanced and graduate work. Both Bale and Gjevre immediately began research, Dr. Bale on various problems involving X-Ray diffraction and Mr. Gjevre on Elastic Properties of Crystals. In 1960 Dr. Bale received a one-year grant from the Research Corporation to be followed by a grant from the Atomic Energy Commission (AEC), the latter in the amount of approximately $10,000 a year for five years plus some pieces of research equipment. In 1961 Mr. Gjevre and Dr. Whalin obtained a research grant from the Air Force amounting to $12,000 a year for a five-year period and, in addition, approximately $30,000 for equipment. Included in the latter was a nitrogen liquefier which has been a valuable adjunct to many of the research programs on the campus; it has also enabled the Department to render a service to many of the cattle raisers in the area.

For several years the Dean's annual report to the President had emphasized the extreme crowding that existed in Old Science, but apparently the first recorded request for a new building appears in the annual report of 1961. The steadily increasing enrollment, the expanded research program with its resulting increase in the number of graduate students, and the presence of the Science Institute had combined to again produce such a serious space problem that curtailment of departmental activities would seem to be the only solution.

One instructor, Mr. Ronald Giedd, with his master's degree from Iowa State University, was added to the staff in the academic year 1961-1962.

In 1962 Dr. Mitchell left the University of North Dakota to assume a position at the University of North Carolina, taking with him his very capable research assistant, Mr. Glenn Lykken, who later was to return to the University of North Dakota Department of Physics.

Additions to the staff were Dr. M. Ali Omar, with his doctorate from the University of Colorado, as assistant professor; Bruce Ellis, recently with his masters degree from the University of North Dakota, as instructor, and Mrs. Mary E. Cox as part-time instructor. Mrs. Cox, the wife of a philosophy staff member, had her master's degree from the University of Michigan and had had teaching experience at that institution.

Dr. Hundley, now approaching retirement, had for several years requested or suggested that he be relieved of the chairmanship of the Department but had, at the request of the Dean, continued in that capacity. In 1963, after a total of thirty-five years of service, thirty-three of which had been as chairman, Dr. Hundley retired to teaching. The following year he retired from the staff.

Throughout those many years Dr. Hundley's service had been one of absolute dedication to the Department and to the University. His problems had been many and varied. Often handicapped by over-crowding, staff shortages, accommodation of War Service Programs and Institutes, recruiting difficulties due to non-competitive salaries, and inadequate mechanician and secretarial help, he gave of himself unstintingly in order that the work of the Department might continue. During those years, too, he saw his Department grow from a staff of three, primarily involved in the teaching of elementary courses, to one of eleven, many of whom were actively involved in graduate and research programs. It should be noted too that at no time during Dr. Hundley's chairmanship had there been anything but friendly cooperation within the Department.

In 1963 Dr. Bale assumed the chairmanship of the Department, following Dr. Hundley. However, realizing that the administrative responsibilities would interfere with his research, he requested that a search for a chairman be continued. In the spring Mr. Gjevre resigned to enter the School of Medicine, Mr. Giedd left the Department to continue graduate work, and Dr. Hundley, after a year of teaching beyond his chairmanship and thirty-six years of service, retired.

Replacements in the academic year 1964-1965 were Dr. Bob Henson, with his degree from Wshington University at St. Louis; Mr. Joseph Streeper, with his master's degree from the University of North Dakota, experience with North American Aviation, and teaching experience at Minot State College; and Mr. William Shene as part-time instructor. Mr. Shene was in the process of completing his master's degree, after several years of teaching in New York state.

In the academic year 1965-1966 Dr. Witmer, who had been on sabbatical leave the preceding year for refresher study at the University of Michigan and the University of California at Riverside, retired from the

Deanship and returned to full-time teaching in the Department. Mr. Weisser was granted a sabbatical leave for study at Ohio State University under a National Science Foundation Fellowship.

A valuable addition to the Department came with the return of Dr. Glenn Lykken who had left the University of North Dakota with Dr. Mitchell under whom he completed his doctoral research working on "Magnetic Resonance in Thin Films." Dr. Lykken, young, energetic and enthusiastic, already with publications to his credit, immediately began research under a National Science Foundation grant and thus added to the research activity under way by Drs. Bale, Whalin, Henson and Omar. His coming also added a fine teacher and a specialist in an area which had become of importance in scientific investigation.

Prior to this the course offering of the Department had been changing to meet demands. The additions had been largely advanced or specialized courses. At all times, however, considerable emphasis had been on offering a basic general course for non-science majors and those not continuing in physics. With the increasing demands for pre-doctoral background, it became evident that a certain sequence of advanced courses was advisable, and to this end a required sequential pattern was established to be followed by all graduate students.

The spring of 1966 was a period of considerable activity and change. The new building first requested in 1961 was assured. The cost of the $1,250,000 building was to be covered by a grant of $416,667 from the U.S. Office of Education and $833,333 from the State General Fund. Considerable study, of course, had gone into the tentative planning. Final planning was done, following visitations to other new buildings in the Midwest by Drs. Bale and Witmer, along with Mr. Robert Ritterbush, the architect. Contracts were let with construction to begin in April of 1967 and to be completed in April 1968. The basement and first two floors of the building were to be occupied by the Department of Physics and the third floor by the Department of Mathematics.(22)

Considerable discussion arose as to the location of the new building. The local administration favored the east side of the so-called "mall," but the Board of Higher Education decided that it should be placed near the Departments of Chemistry and Geology which, along with the proposed erection of an engineering building, would form a science-related complex.

Drastic changes in personnel took place in the spring of 1966. Resigning were Drs. Whalin, Henson and Omar as well as Mr. Streeper, Mr. Shene, and Mrs. Mary Cox. The men left for teaching and research positions at other institutions or with industry; Mrs. Cox left with her husband, who had accepted a position at another college.

---

(22) See "Summary of Facts" about the Physics-Mathematics Building, as prepared by The Office of University Relations, page 21.

SUMMARY OF FACTS ABOUT THE PHYSICS-MATHEMATICS BUILDING

Contents:

Contains 66,000 square feet with all areas air conditioned; three stories and full basement, with the Department of Physics occupying most of the basement and first two floors and the Department of Mathematics the third floor. There is a large lecture hall seating over 200 students; a small lecture room seating 88; 15 classrooms; four elementary laboratories to accommodate 24 students; two advanced laboratories and preparation room for 12 to 18 students; library; departmental offices, 2 seminar rooms, 4 group staff offices; and 28 faculty offices, all grouped by departments; 11 varying size rooms for research; machine shop; glass shop; 2 electronic shops; chemistry laboratory; wood shop; storage and mechanical equipment areas. Overall building dimensions are 225' by 107'.

Cost:

$1,250,000 ($416,667 federal grant approved by the U.S. Office of Education and $833,333 from State General Fund, approved during 1965-1967 biennium) which includes fixed and movable equipment.

Architects:

Ritterbush Brothers, Architects and Engineers, Bismarck, North Dakota.

Contractors:

Witcher Co., Minneapolis, Minnesota, general; Grady Plumbing and Heating, Grand Forks, mechanical; G-M Electric Co., Grand Forks, electrical; Colborn School Supply, Grand Forks, equipment.

Beginning of Construction:

April, 1967.

Completion Date:

April, 1968.

Location:

Eastern edge of campus between Leonard Hall (geology building) and Abbott Hall (chemistry building).

Style:

Modern Collegiate Gothic, with Indiana Limestone and North Dakota Hebron Brick.

Other Features:

Chilled water from a steam absorption unit using high pressure steam from the central plant furnishes the cooling for air conditioning.

Most students enter the first floor by ramps from the west with all parts of the building accessible to the handicapped by the use of the elevator. All restrooms are also equipped for their use.

First floor circulation space has ceramic tile floors, and all corridors have a scuff resistant epoxy wainscot.

Each lecture hall has tiered seating using color-coded swivel chairs and pedestal tables, vertical sliding chalkboard, physics demonstration table and equipment; separate fluorescent and incandescent lighting system with dimmer control and provision for remote projector controls.

All classrooms have a maximum amount of slate chalkboard and recessed lighting.

Provisions have been made throughout the building for the future addition of closed circuit television.

Laboratories, lecture halls, research rooms and a few classrooms are equipped with piped-in gas, air, hot and cold water, sewer and electricity, including central station variable voltage of direct and alternating current.

Each faculty office has carpeted floors, on paneled wall with recessed shelf standards, window drapes, a built-in combination wardrobe, a file and storage unit, an open bookcase, and individual temperature control.

Each research space has its own electric panel with access to an adjacent buss duct for added power requirements.

In addition, Mr. Henderson was granted a leave of absence to serve as "Program Director of Academic Year Study Programs" in the Washington office. He had doubtless been singled out and offered the position on

the basis of his outstanding contributions and interest in teacher training. Unfortunately he did not serve in this new position long. During the summer he had experienced a severe illness and went to Washington in September in a somewhat weakened condition. In late March or early April, while on a trip to Ann Arbor, Michigan, he contracted a cold which developed into pneumonia. He passed away April 17, 1967.

Mr. Henderson's passing was a distinct loss to the Department and to the University. During his twenty-four years on the full-time staff he had been a tireless worker and an outstanding teacher and had contributed much to the general University welfare. By his students and colleagues he was held in the highest esteem.

This exodus of seven, leaving Dr. Bale with a staff of himself, Dr. Witmer, Dr. Lykken, and Mr. Weisser who had returned from his year's leave, created a considerable replacement problem. While replacements in number were not immediately achieved, the quality of those obtained was of the highest.

Additions to the Department for the academic year 1966-1967 were Drs. Murray Muraskin, Henn Soonpaa, and Seshagiri Rao, together with Mr. Lindsay Hess.

Dr. Murray Muraskin is a theoreticist with his B.S. degree from the Massachusetts Institute of Technology and his M.S. and Ph.D. degrees from the University of Illinois. In addition he has had two years of research experience at the University of Minnesota and one year of teaching experience at the University of Nebraska. His field of specialization is in Elementary Particle Physics.

Dr. Henn H. Soonpaa has his B.A. degree from Concordia College, his M.A. from the University of Oregon, and his doctorate from Wayne State University. He has held research fellowships at Iowa State University and at Wayne State University and has had eight years of research experience at General Mills and at Honeywell Corporation Research Center. His teaching experience has been at Gustavus Adolphus College.

Dr. Seshagiri Rao has his B.S. degree from Andhra University, his M.S. from Banaras University, both in India, and his doctorate from Pennsylvania State University. He joined the Department with several years of experience in industrial research and with teaching experience at Pennsylvania State University and Duquesne University.

The fourth addition to the staff, Mr. Lindsay Hess, a fine young instructor from Montana State University, filled the part-time positions vacated by Mr. Shene and Mrs. Cox.

These additions, having a variety of fields of specialization, enabled the Department to continue its broad range of offerings. Dr. Rao immediately began research in Infra Red under a National Science Foundation grant. Dr. Soonpaa began research in Solid State Physics under a grant from the Atomic Energy Commission of $26,330 in 1967 to be followed by grants of $44,700 in 1968 and $35,000 in 1969. In addition

to some equipment under the above $106,000, Honeywell Corporation, through Dr. Soonpaa, donated $5,500 worth of equipment to the Department.

Research grants, such as those above, provide, in addition to summer salary for the chief investigators, allowances of $275 per month for each of three graduate assistants during the school year and for two at $550 per month during the summer months. It is evident that not only are graduate students necessary for the carrying on of research but more important is the reverse; the research programs provide support for graduate students and an aid in recruiting such students.

A department can be strong and progressive only if an atmosphere of research is being maintained, and to recruit and hold a good staff such an atmosphere must exist. It follows then that a strong graduate program, a strong research program, and a strong faculty go hand in hand, each needing and supplementing the others.

By 1967 it became evident that a situation was developing in departments of physics in universities across the country, a shortage of graduate students. At least three factors seemed to be contributing to the problem. The first of these was the greatly increased demand for teachers in the colleges, as a result of increased enrollments and expanded programs. The second was the inroads made by industry and government agencies which were offering positions to graduating seniors at salaries the students felt they could not refuse. The third, often linked with the second, was the draft situation. The uncertainty of being permitted to complete graduate work encouraged the graduating students to enter the service or to enter "essential industries" to obtain deferment.

In the fall of 1967 Dr. Olen Kraus came to the University to assume the chairmanship of the Department. Dr. Kraus is a man of fine academic background and considerable experience. He has his bachelor's degree from Pennsylvania State University and his master's degree and doctorate from Michigan State University. His research experience includes two years as a Standard Oil Fellow and seven years as a physicist with the National Bureau of Standards. Since 1962 he had been teacher and chairman of the Department at the University of South Dakota. Dr. Kraus' field of specialization is in Nuclear Magnetic Resonance, an area already being developed and equipped for within the Department.

A second addition to the staff, bringing it back to former size, was Mr. Thomas O. Meyer who had been a graduate teaching assistant in the Department.

At the time of Dr. Kraus' appointment it was understood that he would direct his efforts toward the development of a doctoral program in physics at the University of North Dakota; he had been assured of support toward this end by the local administration. In November of 1967 he submitted to the Graduate Committee of the University a comprehensive report on the status of the Department along with suggestions for certain additions. Also submitted was an outline of the

proposed doctoral program accompanied by a request for its approval by the Committee.

In the spring of 1968 Mr. Hess left the University for the University of Ohio at Athens to continue graduate work and Mr. Meyer left for a position with Eastman Kodak in Rochester, New York.

An important event in the life of the Department was the move in the summer of 1968 from Old Science, occupied for over sixty-five years, to the fine new Physics-Mathematics building. The building, spacious, completely air conditioned and of functional design, now supplied the long needed facilities for efficient operation.

Additions to the staff in the fall of 1968 were Dr. Tom Clark, Mr. Duane Cole, and Mr. Pierre LePere.

Dr. Clark, with a speciality of Theoretical Solid State Physics, received his bachelor's and master's degrees from the University of Illinois and his doctorate from the University of Kansas. In addition he had had one and one-half years of research experience with Internation Business Machines.

Mr. Duane Cole, with his bachelor's degree from Morningside College and his master's degree from the University of South Dakota under Dr. Kraus, had had four years of teaching experience in high school and one year at the University of South Dakota.

Mr. LePere, a graduate of Bemidji State College, had received his master's degree from the University of South Dakota also under Dr. Kraus. He came to North Dakota with two years experience as a graduate teaching assistant at the University of South Dakota and two years as instructor at Montana State University at Bozeman.

The shortage in the supply of graduate students had not seriously affected the University of North Dakota by 1968. But reports of what was happening at other universities and the nature of the inquiries from prospective students regarding graduate study made it evident that a doctoral program was not only advisable but necessary if the Department were to continue to operate creditably. This was not only true in order to attract high quality graduate students and to hold a strong staff but also to be in a competitive position in applying for research funds.

Dr. Kraus, now with a very strong staff and with facilities entirely adequate for the offering of a doctoral program, continued to press for the approval of the program requested in November 1967. Action on the request, however, was extremely slow. When finally presented to the Board of Higher Education, it met with repeated postponements.

On January 3, 1969, by arrangement through President Starcher, Drs. Kraus, Bale, Soonpaa and Witmer appeared before the Board of Higher Education in Bismarck to discuss the program and again request its approval. However, no action was taken at that meeting nor at several subsequent meetings.

At a meeting of the Board of Higher Education being held at the University of North Dakota October 17-19, 1969, it was decided that the name of the new Physics-Mathematics building be publicly announced. At an alumni luncheon October 18 among alumni and friends of the University, President George Starcher announced that the new building would be named "Witmer Hall in honor of Dr. and Mrs. Witmer."

The dedication of the building took place on June 7, 1969, as planned by a committee under the chairmanship of Dr. John Penn. The formal dedication program was held in the main lecture hall of the new building with Dr. Olen Kraus, chairman of the Department of Physics, presiding and Dr. Mark Ingraham of the University of Wisconsin delivering the main address.(23)

The academic year 1969-1970 is one marked by considerable change. Dr. Harold Bale is on a leave of absence for the year to return to the University of Missouri to devote his time to study and research. His temporary replacement is Dr. Francis Howell who recently received his doctorate from Montana State University at Bozeman. Dr. Glenn Lykken is on a one year's leave as Visiting Assistant Professor at the University of North Carolina at Chapel Hill. While he is devoting most of his time to research, he is, in addition, doing some special lecturing and conducting of seminars. His replacement for the year is Dr. James W. Harrell, Jr., who recently received his doctorate from the University of North Carolina.

The field of specialization of each of the above mentioned replacements is magnetic resonance, an area of investigation in which the Department of Physics at the University of North Dakota has developed considerable strength.

Dr. Soonpaa's grant from the Atomic Energy Commission has been extended, and the research activity of the Department recognized by the granting by the National Science Foundation of a helium liquefier.(24) This appreciably extends the low temperature limits at which such investigators as Drs. Kraus, Soonpaa, Lykken and others can work below the limits now obtainable with the use of liquid nitrogen.(25)

Additional recognition of the work of the Department came when Dr. Seshagiri Rao was notified of his appointment as a Research Professor for the summer of 1970. Under a Hill Foundation grant Dr. Rao will be continuing his research in the area of High Resolution Infra Red Spectroscopy.

---

(23) Dr. Ingraham, Dean Emeritus and Professor of Mathematics at the University of Wisconsin, was a long time acquaintance of Dr. Witmer's during their Deanships.

(24) Valued at $26,000. Installed in December 1969.

(25) To approximately -271°C with helium as compared to approximately -196°C with nitrogen.

Another noteworthy event of the year will be the coming to the Department of Physics in May 1970 of Dr. Florian Abeles from the University of Paris. Dr. Abeles will be in the Department for a period of six months on a "Senior Foreign Scientist Fellowship" supported by the National Science Foundation. During his stay at the University Dr. Abeles will be devoting his time to lecturing, the conducting of seminars, and writing.

At its December 1969 meeting held at the University of North Dakota, the State Board of Higher Education approved the Department's request to begin a doctoral program in physics. The action by a vote of five to one, marked the culmination of the long campaign for such a program.

The conditions of the approval indicate that students may be admitted to candidacy in the program after September 1971, and that a doctoral program in physics at North Dakota State University may be implemented at a later date to be determined by the Board.

With the close of the academic year 1969-1970 Dr. R. B. Witmer will be retiring from the staff of the Department and of the University, having completed forty-six years of service, seventeen of which were as Dean of the College of Science, Literature and Arts.

The future of the Department of Physics at the University of North Dakota appears to be bright. Now with its complete program, under strong leadership, and with a young, well-trained, energetic and enthusiastic staff, well-housed in a spacious and functional building, the Department's potential is second to none on the campus.

APPENDIX A

PRESIDENTS OF THE UNIVERSITY OF NORTH DAKOTA
1883-1970

William Maxwell Blackburn	1883-1885
Henry Montgomery (acting)	1885-1887
Homer B. Sprague	1887-1891
Webster Merrifield	1891-1909
Frank L. McVey	1909-1917
Earle J. Babcock	1917
Thomas F. Kane	1918-1933
John C. West	1933-1954
George W. Starcher	1954-

APPENDIX B

CHAIRMEN OF THE DEPARTMENT OF PHYSICS
UNIVERSITY OF NORTH DAKOTA
1883-1970

Horace B. Woodworth, 1883-1887
B.A. Dartmouth-Diploma Hartford Theological Seminary

Ludvic Estes, 1887-1898
Ph.D. University of Michigan

C. J. Rollefson, 1898-1903
Graduate work at the University of Minnesota and Cornell University

George W. Stewart, 1903-1909
Ph.D. Cornell University

A. Hoyt Taylor, 1909-1917
Northwestern University and the University of Michigan
Ph.D. University of Gottingen

Bartholomew J. Spence, 1917-1920
B.A. Northwestern University, Ph.D. Princeton University

Karl H. Fussler, 1920-1929
B.A. University of Indiana, Ph.D. University of Pennsylvania

John L. Hundley, 1929-1963
B.A. University of Missouri, Ph.D. University of Chicago

Harold D. Bale, 1963-1967
B.A. Concordia College, Ph.D. University of Missouri

Olen Kraus, 1967-
B.S. Pennsylvania State University, Ph.D. Michigan State University

APPENDIX C

PERSONNEL OF THE DEPARTMENT OF PHYSICS
(Rank of Instructor and Above)
UNIVERSITY OF NORTH DAKOTA
1883-1970

Mathematics--Physics--Astronomy

1883-1887	Horace B. Woodworth
1887-1898	Ludvic Estes
1898-1899	C. J. Rollefson
1899-1901	D. J. Rollefson--Physics, Astronomy
	Elwyn F. Chandler--Mathematics
1901-1902	Science Hall completed and Department separated

Physics and Astronomy

1901-1902	C. J. Rollefson
1903-1909	George W. Stewart
	Jens M. Rysgaard (Mathematics and Physics)
1909-1910	A. Hoyt Taylor
	Bartholomew J. Spence
1910-1917	A. Hoyt Taylor
	Bartholomew J. Spence
	Edward B. Stephenson
1917-1919	A. Hoyt Taylor (on leave)
	Bartholomew J. Spence
	William R. Brackett
1919-1920	Bartholomew J. Spence
	William H. Bair
	Pearl I. Young
1920-1921	Karl H. Fussler
	M. Thornton Dow
	Pearl I. Young
1921-1924	Karl H. Fussler
	Cecil W. Byers
	John L. Hundley
1924-1928	Karl H. Fussler
	Cecil W. Byers
	Robert B. Witmer
1928-1929	Karl H. Fussler (on leave)
	Cecil W. Byers
	Robert B. Witmer
	Melvin Hetland
1929-1930	John L. Hundley
	Cecil W. Byers (on leave)
	Robert B. Witmer
	Myrtle Sands

1930-1931	John L. Hundley
	Cecil W. Byers
	Robert B. Witmer
1931-1932	John L. Hundley
	Cecil W. Byers
	Robert B. Witmer (on leave)
	Myrtle Sands
1932-1933	John L. Hundley
	Cecil W. Byers
	Robert B. Witmer
1933-1942	John L. Hundley
	Robert B. Witmer
	Cecil W. Byers
1942-1943	John L. Hundley
	Robert B. Witmer (on leave--war service)
	George Feinstein
	Raymond Staley, Jr.
1943-1947	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
1947-1950	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	William E. Thornton
1950-1953	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Robert Wild
	Victor Kaufman
1953-1954	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Victor Kaufman
	Harold D. Bale
1954-1955	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Victor Kaufman
	Harold D. Bale
1955-1957	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Van O. Nicolai
	Kenneth L. Hartt
1957-1958	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Wilbur O. Weisser
	Lyle Buckwitz
	Gordon Lerfald

1958-1959	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Earl N. Mitchell
	Wilbur O. Weisser
	Gordon Lerfald
	Lyle Buckwitz
1959-1960	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Harold D. Bale
	Earl N. Mitchell
	Wilbur O. Weisser
	John Gjevre
	James Cross
1960-1961	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Harold D. Bale
	Earl N. Mitchell
	Wilbur O. Weisser
	John Gjevre
1961-1962	John L. Hundley
	Robert B. Witmer
	Edwin A. Whalin
	J. Donald Henderson
	Harold D. Bale
	Earl N. Mitchell
	Wilbur O. Weisser
	John Gjevre
	Ronald E. Giedd
1962-1963	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Harold D. Bale
	M. Ali Omar
	Wilbur O. Weisser
	John Gjevre
	Bruce Ellis
	Mary E. Cox (part-time)
	Ronald E. Giedd
1963-1964	Harold D. Bale
	John L. Hundley
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	M. Ali Omar
	Wilbur O. Weisser
	Ronald E. Giedd
	Bruce Ellis
	Mary E. Cox (part-time)

1964-1965	Harold D. Bale
	John L. Hundley (emeritus)
	Robert B. Witmer (on leave)
	J. Donald Henderson
	Edwin A. Whalin
	Bob L. Henson
	M. Ali Omar
	Wilbur O. Weisser
	Joseph B. Streeper
	Mary E. Cox (part-time)
	William R. Shene (part-time)
1965-1966	Harold D. Bale
	John L. Hundley (emeritus)
	Robert B. Witmer
	J. Donald Henderson
	Edwin A. Whalin
	Bob L. Henson
	Glenn I. Lykken
	M. Ali Omar
	Wilbur O. Weisser (on leave)
	Joseph B. Streeper
	Mary E. Cox (part-time)
	William R. Shene (part-time)
1966-1967	Harold D. Bale
	John L. Hundley (emeritus)
	Robert B. Witmer
	J. Donald Henderson (on leave)
	Murray Muraskin
	Henn H. Soonpaa
	Glenn I. Lykken
	B. Seshagiri Rao
	Wilbur O. Weisser
	Lindsay Hess
1967-1968	Olen Kraus
	John L. Hundley (emeritus)
	Robert B. Witmer
	Harold D. Bale
	Murray Muraskin
	Henn H. Soonpaa
	Glenn I. Lykken
	B. Seshagiri Rao
	Wilbur O. Weisser
	Lindsay Hess
	Thomas O. Meyer
1968-1969	Olen Kraus
	John L. Hundley (emeritus)
	Robert B. Witmer
	Harold D. Bale
	Murray Muraskin
	Henn H. Soonpaa
	Tommy D. Clark
	Glenn I. Lykken
	B. Seshagiri Rao
	Wilbur O. Weisser
	Duane R. Cole
	Pierre H. LePere

1969-1970	Olen Kraus
	John L. Hundley (emeritus)
	Robert B. Witmer
	Harold D. Bale (on leave)
	Murray Muraskin
	Henn H. Soonpaa
	Tommy D. Clark
	James W. Harrell, Jr.
	Francis L. Howell
	Glenn I. Lykken (on leave)
	B. Seshagiri Rao
	Wilbur O. Weisser
	Duane R. Cole
	Pierre H. LePere

APPENDIX D

HONORARY DEGREE CITATION FOR A. HOYT TAYLOR
Presented at the University of North Dakota, June 9, 1953

Dr. A. Hoyt Taylor was born in Chicago on New Year's Day 1879. He attended high school in Evanston, Illinois, and graduate from Northwestern University in 1902. It was in 1899 during his junior year in college that he began his first research with electromagnetic waves. After graduation he became instructor of physics first at Michigan State and later at the University of Wisconsin.

In 1908 he returned to his studies and receiyed his doctorate at Gottingen, Germany; specializing in electricity and mathematical physics. In 1909 he returned to the United States and was appointed Professor of Physics and Head of the Department at the University of North Dakota. It was here early in 1911 that Dr. Taylor started his radio work in earnest and constructed the station later known as 9YN. He was a pioneer in many phases of radio and while at North Dakota studied especially wave propagation phenomena, fading, influence of weather and directional systems. It was in "Old Science" on this campus that Dr. Taylor's distinguished career as a radio research scientist was launched. He writes, "With a total department budget of less than $1,000 I was unable to divert more than $200 to research."

When the entry of the United States into World War I seemed imminent, Dr. Taylor was commissioned in the Navy. During his five year tour of active duty he was successively Superintendent of Communications of the Ninth, Tenth and Eleventh Naval Districts, Superintendent of Trans-Atlantic Communications and Officer in Charge of the Experimental Radio Division of the Navy Air Station at Hampton Roads. After the war Dr. Taylor assumed direction of the United States Naval Aircraft Laboratory where he worked on the development and improvement of aircraft radio.

When the Navy Research Laboratory was established in 1923 he was appointed Superintendent. The headship of this largest of navy research groups placed him in a position where his influence was felt not only in the development of the Laboratory itself but in the entire field of Navy radio. It was largely a result of experiments and demonstrations carried out at the Laboratory that our Navy converted from long to short wave-length communication with the resulting benefits. Dr. Taylor's personal contributions to the radio art include the development of the theory and practice of propogation of high-frequency energy, the development of the quartz crystal oscillator and the development of high and super frequency radio communication systems which have done so much not only for the Navy but all government and commercial services.

Dr. Taylor will perhaps be best remembered for his share in the discovery and development of high frequency techniques known as radar. As early as 1922 he and his assistants demonstrated the amazing possibility of detecting and tracking targets by radio waves.

It was under Dr. Taylor's far-seeing leadership that this weapon which had such a profound effect in World War II was perfected. "The father of radar."

Aside from his achievements for the Navy, Dr. Taylor has won wide and repeated recognition in the world of science. In 1927 he was awarded the Morris Liebmann Memorial Prize; in 1929 he was elected President of the Institute of Radio Engineers; in 1941 he was presented with the IRE's medal of honor and in 1942 the John Scott Medal of the Franklin Institute. In 1944 for his outstanding work in radar he was awarded the U.S. Presidential Medal of Merit. The citation reads: "For extraordinary fidelity and exceptionally meritorious conduct in the research and experimentation resulting in the discovery and development of radar."

Always the student, Dr. Taylor has among his hobbies classical music and the study of modern languages. In addition to the French, Dutch, Spanish, German and Italian which he learned in the past, he has recently learned to read Russian and at the present time is absorbed in mastering Chinese. He is known among his friends as a great scientist, a great scholar, and a true gentleman.

President West, it is with much pleasure and pride that I present the name of A. Hoyt Taylor as the recipient of the honorary degree of Doctor of Science from the University of North Dakota. I regret that Dr. Taylor must receive the degree in absentia.

R. B. Witmer, Dean
College of S.L.A.

APPENDIX E

DEDICATION CEREMONIES OF WITMER HALL
For the study of mathematics and physics at the
University of North Dakota in Grand Forks

June 7, 1969
An Address By
Dr. Mark Ingraham
Dean Emeritus and Professor of Mathematics
University of Wisconsin

When I was first invited to speak on this occasion little did the dedication committee know how inevitable it was that I would accept. First, my affection for mathematics and my high regard for physics drew me; secondly, it is a great privilege to share in honoring Dean Witmer; and, finally, every retired faculty member has an almost irresistible urge to advice--an urge he strives to curb at home but to which he gives free rein elsewhere.

I am delighted that this building will bear the name of Robert Witmer. By all rights I should be resentful. If any persons take more liberties with mathematics than the engineers, they are the physicists. Dean Witmer started out to be an engineer and became a physicist, but he became more than an engineer and more than a physicist. He became a man who saw the role of knowledge in its unity, and cared for people, young and old. Is there greater praise than "he respected excellence and loved his fellow man"?

He was born in this Red River Valley just south of the Canadian border. He has spent his life in this State, even if twice he left it for military service and occasionally studied elsewhere so that he might return to enrich its life. Of the two subjects he reported as specialities, one was "resistivity of North Dakota clays." This was not name-calling by an ex-dean of freshmen, but a labor of affection for his native soil.

Many catalogues describe the object of the college in terms rarely attained. Yours reads: "The long-range goal is that of producing a well-rounded individual--intellectually, spiritually, emotionally and aesthetically. The college seeks to accomplish this primarily by emphasis on intellectual achievement." In the Witmers the University has twice reached its goal. Of course it had half a century to attain this end.

Seldom is a university building named after a living person--unless a generous donor desires that it be done. This building is no exception. The chief donor was the people of North Dakota. No two persons are more closely identified with the State or its University than Robert Bonner and Lillian Leith Witmer. The people of the State, and especially the graduates of the University, wished this building to be named after Dean Witmer and rejoice at the action of the Regents in doing so. The donors' desires are honored.

Enough! If Witmer is the same man I used to meet as a fellow member of the ADLACSUMV, more would embarrass him.

Witmer Hall has had Mr. and Mrs. Witmer as godparents since before it was opened, and today is being officially named. We may then turn to consider its use as a center of physics and mathematics.

This building is dedicated to twin sisters--very like in appearance and very different in temperament--physics and mathematics. They dress in integral signs, adorn themselves with matrices, and bristle with vectors. Both look at the heavens: one wonders about the nature of the stars; the other about the nature of the space between. The physicist considers 39 as the atomic number of yttrium, the mathematician thinks of it as the first number which is the sum of the squares of four distinct primes. Since nature has implanted a sense of space, time and number in our minds, the mathematician introspectively studies them and other ordered structures. The physicist takes these ordered structures, or whatever he understands them to be, and uses them to describe nature. They both seek beauty and order--one in the ordered mind; the other in ordered phenomena. Mathematics and physics will always be sisters, and they had better live together so that they can quarrel in private.

We should try to develop some ideal of what the life of man should be and point our work toward making that ideal come true. In our own lives we should try to fulfill as much of that ideal as we can. Many do the first but not the latter. This is perhaps particularly true of the modern scholar, who seeks to improve the world while dwelling in a self-imposed prison. No man's ideal is complete, and of course it is unrealized even as his career draws to a close. Perhaps we could not even list the major components of such an ideal, but from a long list it is always possible to pick a few to stress on a particular occasion. Today I mention three: accomplishment, responsibility and appreciation wedded to a sense of proportion. These are not separate but interwoven.

It is not easy to strike a balance between emphasizing the central importance of physics and mathematics and the fact that they together are still only a minor portion of our intellectual heritage.

For the moment, however, let us focus on their part in modern life, forgetting both their beauty and the contributions of other disciplines. No physicist is happy with the engineer who thinks that physics is merely one of his tools; and no mathematician is happy with the physicist who has the same attitude toward mathematics. Yet both of us should be happy that we are useful even to the heathen. We should also shudder. No technological theme has been more persistent than the search for means to increase the energy at man's disposal. For the master, the serf was such an increase. The bow permitted the storage of energy for sudden release. The horse, the windmill, and the water wheel enormously increased the force at man's command. Steam ushered in an era, and electricity made transmission of energy possible. Man is now vying with the cabbage in the use of solar energy, and the release of nuclear energy has stepped-up the available supply by a far greater

factor than the muscles of a horse compared to those of man. But no one worried that the horse might destroy man. From the lever of Archimedes to the equation of Einstein, it is physics that must receive the greatest credit or blame, though it was aided by mathematics. Another great quest was to learn to count rapidly. Adding, multiplying and integrating are but extensions of counting. The notion of one-to-one correspondence, which seems to puzzle parents when helping children through the "new mathematics," is a basic idea which goes back as far as history. (Incidentally, perhaps the chief advantage of these new methods of teaching is that they have reduced the role of the parent.) Digits are named for fingers and toes. Putting on shoes insured the triumph of ten as a base for our number system over its rival the score. Calculus is named for pebbles, an early means for recording numbers. The modern computer performs in a reasonable time calculations that were only theoretically possible before its advent. It was not any greater advance than changing from the Roman to the Arabic number system. The history of computing is essentially mathematical, though for once the mathematician has made servants of the physicist and the engineer to develop machines for his use.

Illustrations are without number, but the lesson is clear. Remove mathematics and physics, and today's civilization could not be recognized.

In a complex society it always seems easy to shift responsibility. Indeed it is difficult to determine fault or credit. A scientist, looking at the increase in public health, in transportation, in kilowatt hours or in the exploration of the solar system, claims credit along with cash. Blame too easily is thrust aside. Thus, some say, if population brings on famine, this is the fault of parents. If automobiles, like war, selectively kill the young, this is the fault of the drivers. If nuclear energy should wipe out life, it would be the fault of the politicians and generals. And the scientist may be willing to break the bank while crying for the moon. One cannot drop a stone in a pond and control the ripples. But a cavalier attitude toward the outcome of one's handiwork is intolerable. The first murder was committed by the man who asked: "Am I my brother's keeper?" The awakening conscience of scientists to the fact that they threaten through famine, pollution, incineration and extravagance a society they have already blessed, is good if it is not too late. On the other hand, the scientists must not arrogantly assume that they are best fitted to guide society. Rarely is this the case. But they can add a voice knowledgeable in many aspects of our problems. If democracy is to succeed in an age where technology is beyond our ken, the people must make decisions based on information about the import of science provided to them by those who know the facts of science. If it is to be used for good rather than for evil, this information must be given in relation to opportunities, dangers and ideals. Not only the clear mind but the compassionate heart must speak. Let not the luster of gold bind us to the glimmer of the stars, nor the noise of the bull horn deafen us to the voice of conscience.

I suppose every administrator worries about the shift in loyalties from the university to the department, to the learned society, or even to the

foundation that supports one's project. In so far as this is a shift of devotion from on organization to another, it may not be of great significance; but to the extent that it places specialization in a given field above the total human intellectual enterprise, it is unfortunate. Today demands bewildering adjustments in our thinking. We will constantly change course, by drift, if not by rudder; and intelligence at the helm must take account of the drift.

The mere specialist is a slave serving the wayward desires of others. The specialist who also shares our cultural and ethical inheritance and strives to preserve and enhance it, may become a senior partner in the firm.

One of the dilemmas that we face is that the total amount of knowledge is so great and its rate of acquisition so fast that no human mind can comprehend it in detail. For that matter, no human mind can comprehend either physics or mathematics in detail. The desire to penetrate the unknown is as compelling and as useful today as in the past. New knowledge will be acquired by those who know a great deal about a few related topics--hence, specialization. The man who will advance our knowledge of groups or of nuclear physics must know a great deal about automorphs or linear accelerators. In these particular enterprises Dante, Shakespeare, Mendel, Pasteur, Buddha will not help him. It is his life, not his job, that requires these masters. Knowledge comes from men who can focus. I want specialization; I am not sure that I want the specialist. When success is valued above appreciation, something fine is lost.

What is the use of one new fact whether it concerns the behavior of an electron or a matrix? In the first place, there is the delight of personal accomplishment. This is good; for he who would serve others should bring some joy to himself. Moreover, because of a discovery the discoverer is a more confident searcher and a better teacher, for no plant is understood until its principle of growth is glimpsed. After discovery the fact is reported; listed in an abstract journal printed in a periodical, perhaps stored on tape for quick retrieval, and certainly reported to the dean. This process is sometimes very helpful; but at other times it forms a hurdle, placing upon the scholar an obligation to know past results, when frequently he could more easily consult nature or rediscover a theorem than examine the literature.

The discovery is most useful if the discoverer, or someone else, uses it to help form a unifying theory or applies it to the welfare of mankind.

This brings me to one of my favorite theses. A disproportionate share of our scientific energy is going into seeking new knowledge as compared to organizing the known. I believe that one basic reason for this is that discovery is easier than organization, yet, strangely, it receives more honors. Even dissertations are described as "original contributions to human knowledge." Many are; but few are anywhere near as important or as original a contribution as that made by the man who goes through a mass of other people's observations, organizes them into a structure, points out which ones lead to others, which lead to open questions, and which may be applied to other fields or other branches

of the same subject. That greatest of all scientific books, Newton's "Principia," reorganized the work of Kepler and Copernicus and also made tremendous additions of its own--all in terms of classical geometry. Newton's own work in calculus had to be reinterpreted by others before it was of general use. Even a textbook, if it is the first good one in the field, may be of great importance to the development of science. Euclid's was!

I hope that from this building will flow much new knowledge, but I also hope that it will contain men who understand as well as know.

But Witmer Hall will not be worthy of its name if it does not remain the home of good teaching--teaching that is enthusiastic about mathematics or physics and that reflects the magnificent role of these subjects in the drama of the human intellect; teaching that is informed by a desire to know, to understand, but also to share. When Dean Witmer and I started our administrative duties, we often had to point out that scholarship, usually--but not always--in the form of research, is a requisite of good teaching. Today the other requisites, preparation, the conscientious attempt to communicate, and sympathy, are in some instances shoved aside by the all-engrossing desire for scientific success. Hence, we now must remind the scholar that the future of his subject depends on public understanding and support and a continued supply of young men and women entering the field. These will not exist in the absence of good teaching. I have had a long-time suspicion of a person who says he cannot be a teacher and a scholar at the same time--no matter what he makes his excuse for neglecting the other.

Can I describe the good teacher? I cannot. I can mention a few ingredients that are almost always present, but I am not sure that there are not exceptions. Among these are knowledge of the subject and enthusiasm for it, a desire to stimulate students, and a willingness to work.

Let me tell you of two great teachers. I was a student of one; the other I knew only fleetingly.

The method of teaching of the first was to try to do research at the blackboard with what aid he could get from his students. He taught a six-semester sequence in general analysis. He started with twenty students and ended with two. Eighteen he discouraged; the other two--he sometimes did. He spent a few periods getting to the frontier of his field and then struggled to enter new lands. His class started at 11:00 a.m., so that no following class would interfere with his going on and on. Lunches were often very late. Most of the time he was as inarticulate as unformulated thought. Often he was frustrated and irascible. But there were wonderful breakthroughs when students and professor rejoiced together. Once I was in a group of mathematicians who amused themselves naming the leading mathematicians this country has produced. The three who headed the list had all written their theses under E. H. Moore.

The second teacher was Alfred North Whitehead, mathematician and philosopher. I know nothing of his work in class, but I have been a guest at the dormitory where he lived and chatted with students after dinner. Brilliant in conversation; his suggestive mind stirred all around him, and his knowledge was prodigious. On another occasion, a delightful June evening outdoors, I was part of a group with Whitehead. He held the floor and talked on how the British had defeated the Spanish Armada. He knew the drafts of the ships as well as the types of rigging they carried. He knew the winds that were blowing, the conditions of the tides, and how far below the surface were the Goodwin Sands. It was one of the finest exhibits of the play of a great mind about a topic outside its field.

Between these two men, contrast was more striking than likeness; yet besides knowledge and enthusiasm, they shared with the scholar we honor today a deep respect for the function of a teacher.

Within this building should dwell successful men, responsible men, but also men of appreciation. Success is a subordinate goal. Responsibility is a duty. Appreciation is a blossoming. First, one should appreciate one's own field. I shall speak of mine, since I am so bumble-fingered that the laboratory to me was a low-grade torture like an incipient toothache. I am glad that people enjoy wrenching from nature her secrets--though it has always seemed to me to be a bit sadistic. But when a burst of insight turns such forced confessions into a differential equation, the delight is one I can share. Mathematics has been called a language; it is, but it is more! Mathematics has been called a science (this allows the NSF to support us); but mathematics is also an art--the source of aesthetic pleasure--an art through the order of its organization, the interrelation of its parts, the engrossing variety of its details. Like a cathedral with its basic symmetry and its soundness of structure, mathematics has the richness of pictured windows and its own grotesque gargoyles. It lends itself to a variety of arrangements. As there are individual styles of poetry, so are there individual styles of proof. The garb of a beautiful woman reflects both her taste and the tastes of those she would please.

But the somewhat elite joys of mathematics or physics are not enough. I get angry with my literary colleagues who declare that scientists, whether social or natural, are uneducated illiterates. I get angry because often they are correct; and I am disgusted because frequently they prove themselves to be the same.

I suppose that nearly all of us are illiterate in some area, for instance, I am in music. A friend of mine, an eminent physicist, once tried to tell me where I could find pancakes and maple syrup in Paris. He was an intellectual aristocrat and a gastronomic illiterate--in spite of the undoubted merits of pancakes and maple syrup. But it is hard to condone lack of informed appreciation of all literature, or of all social studies, or of all sciences, or of all the beauties of nature.

Some devotees might query: "Is not the beauty of mathematics sufficient for our needs?" I think not. You are on the flyway of the Canada goose, and you are impoverished if you do not respond to its

wild call. You are in the land of flax whose glory defies the blue of heaven; you are impoverished if you do not respond to this glory. Both are more than wavelengths measured by an oscillograph or a spectroscope.

Newton was a revealer of order--but so were Darwin and Adam Smith. The library at the University of Wisconsin will bear a quotation from Charles Slichter, an applied mathematician, "Remember you are all mentioned in the will of Homer." If Homer had not spoken to universal man, his epics would have died with Troy. Physics and mathematics are sparkling jewels which gain from their setting in the crown.

Perhaps no subject gives us needed perspective so well as history, perspective in time but also perspective as to our present functions. I am an enthusiast for the history of science, particularly when taught by those who can bring it up to date. The constant proliferation of detail followed by the discovery of unifying principles is a recurrent process: confusion, clarification, exploitation, again and again, but always with new leaves growing from the humus of the old. History always repeats--yet never repeats. I am not sure tha knowledge is more confusing today than just before Euclid, or just before Newton, or just before the rediscovery of Mendel.

History also gives us a chance for wholesome hero-worship. My wife etched a bookplate for me. It depicts three niches in the temple of mathematics. In two are Archimedes and Newton, the only two men I know who were supreme in both physics and mathematics. In the third was Fermat. Any mathematician or physicist could adapt this by replacing Fermat with an exemplar of his particular interests. One is both exhilarated and humbled by such company.

However, the scientist should not believe that the history of science is the only history he needs. He needs political, social, cultural and the broader intellectual history as well. How lonely the interplanetary vacuum would be without communication with the earth! There must be some potential theory that tells us how rapidly the value of a subject diminishes as its distance from other fields increases.

It is a privilege to be with you today, to share your pleasure in dedicating a building devoted to two great expressions of the intellect, and to honor a scholar, a gentleman, an effective leader and a beloved human being. It is a joyous occasion in the midst of troubled times. Especially in troubled times, when much is questioned, it is well, as scientists, as teachers and as citizens of the community of the mind, to heed the admonition: "Prove all things; hold fast to that which is good."

THE DEPARTMENT OF PHYSICS
UNIVERSITY OF NORTH DAKOTA

A History update, 1970 to the present.
By Professor Wilbur O. Weisser

The 1970's represent a decade during which the Physics department made considerable progress despite encountering some difficult problems. The long sought doctoral program was finally implemented, but the problem of student recruitment for the graduate programs continued. Enrollments in physics programs followed the nationwide decline which began in the mid sixties and employment opportunities for graduates failed to improve until late in this period. The problem of recruiting graduate students was further hampered when external funds for the support of research became more difficult to obtain.

At its January 1971 meeting the State Board of Higher Education reversed its 1969 decision to permit a doctoral program to begin in September 1971. Implementation was to be deferred until "demand increases" and could not be effected without further approval from the board. Upon recommendation by the Graduate Committee of the University, President Thomas J. Clifford and VPAA William Koenker again sought approval at the December 1973 meeting. Approval was granted at that meeting. The doctoral program was implemented in August 1974, and several students were admitted to it at that time.

The 1970's marked a period of faculty stability. Undoubtedly, influenced to some extent by the tight job market for physicists, there was very little turnover in the Department's faculty. Dr. R. B. Witmer retired from the staff in 1970. Pierre H. LePere resigned in 1970 to accept a teaching position in the Physics department of Bemidji State College in Bemidji, Minnesota.

Dr. Olen Kraus spent the academic year 1973-74 on sabbatical leave at the University of Colorado dividing his time between teaching, research and studies in astrophysics. Mr. Wilbur O. Weisser served as acting chairman and Mr. Michael L. Jones, a 1973 M.S. recipient from the Department, served as instructor and research assistant to help offset the absence of Dr. Kraus. When Dr. Kraus returned to devote full time to teaching and research in August 1974, Mr. Weisser assumed the chairmanship of the Department. Beginning with the 1975-76 academic year, Dr. Kraus began dividing his work between serving as Associate Dean, College of Arts and Sciences and Professor of Physics. His service as Associate Dean began as part-time basis in 1975-76 but developed into a half-time position in 1977. It has continued at that level.

Dr. B. Seshagiri Rao spent the summers of 1975 and 1976 as well as the academic year 1975-76 on developmental leave at Toronto University. He pursued studies and research in the field of light scattering with the internationally known Dr. Boris P. Stoicheff.

Dr. Harold D. Bale was on developmental leave during the second semester of the 1977-78 academic year. He devoted this time to research in x-ray diffraction studies at the University of Missouri.

Dr. James W. Harrell was on leave from the department during the academic year 1979-80 while serving as a visiting professor in the Physics Department at the University of Alabama. He resigned in May 1980 to accept a permanent position at Alabama.

Dr. Tommy D. Clark was on leave during the academic years 1979-80 and 1980-81 while serving as group leader of a research team with Analog Devices, Inc., Semiconductor in Wilmington, Massachusetts. He resigned in May 1981 to continue in the same position with Analog Devices, Inc.

The only addition to the staff in this period was Dr. William A. Schwalm who joined the faculty in 1980. Dr. Schwalm, with a specialty of Solid State Physics, received his bachelor's degree from the University of New Hampshire and his doctorate from Montana State University. He had two years of teaching and research experience at the University of Utah, Salt Lake City. An extremely energetic individual, Dr. Schwalm has particular research interests in surface physics and in the localization phenomena in thin films. He provides theoretical support for the solid state experimentalists in the Department.

The difficulties of procuring funding for research and maintaining a desirable graduate enrollment were the major problems of the Department in the 1970's. Graduate enrollments averaged from six to eight full time students annually from 1972 to 1975 then rose to a maximum of thirteen in 1976-77. This was no doubt, in part, due to the implementation of the Ph.D. program in 1974. By 1977, external funding for research in the department dropped to its lowest level. Combined with the paucity of bachelor's degree recipients in physics throughout the nation, this funding problem caused a sharp decline in the graduate enrollment of the Department, which dropped to three full time students in 1979-80.

External funds appeared to be more readily available for interdisciplinary research efforts during the 1970's. Several men in the department took advantage of these opportunities. Dr. Francis L. Howell, in collaboration with geology faculty, received funding in the amount of $30,000 for a two year period to continue his "terrestrial heat flow studies in the Williston Basin Region" which he had initiated in 1972. Subsequent funding was obtained from the U.S. Geological Survey and from the Department of Energy through the Engineering Experiment Station. The funds so obtained provided support for several graduate students through 1980.

The presence of the Human Nutrition Laboratory (HNL) near the campus and its work with human subjects and nutrition interested Dr. Lykken. During professional associations with HNL personnel, he saw the possibilities of applying physics to the solution of medical and biological problems. As a result, he instigated the concept of a Neutron Activation Analysis Laboratory. To develop this laboratory he headed a

team including Dr. Rao of the Physics Department, Engineering College faculty, and personnel from the Engineering Experiment Station and HNL. A 10 milligram Californium-252 source valued at $106,000 was received on loan for a four-year period from the Californium-252 Demonstration Center for use in the trace element analysis of biological samples. This project provided thesis research for several graduate students.

The physics graduate programs were reviewed by the Graduate Committee of the University during February-March 1977. This review included external consultants for the first time; Dr. Allan H. Morrish, Professor of Physics at the University of Manitoba, Winnipeg and Dr. Maurice B. Webb, Professor of Physics at the University of Wisconsin, Madison. As expected, the primary concerns expressed by the reviewers were the lack of sufficient research support funds and the small number of graduate enrollments. The staff and facilities of the department were judged to be strong.

After a follow-up review during 1979-80, the department was exhorted to make continued efforts at improving enrollment. Strong efforts, already underway, were very much enhanced when graduate teaching assistant stipends were sharply increased for the 1980-81 academic year. Dr. Howell, as coordinator of recruiting, began a systematic effort through visits to colleges in the immediate three-state area to bring more students into the graduate program. Positive results were noticed rather quickly as four new graduate students were enrolled in August 1981. This recruiting effort is scheduled for continuation in subsequent years on an expanded basis. It is planned to include contacts with colleges in North and South Dakota, Minnesota, Nebraska, Iowa, and Wisconsin.

The instruction and research components of the Physics Department depend upon the use of equipment and apparatus which may vary in design and construction from simple to extremely sophisticated. Equipment is one of the major items on the annual budget. Highly subject to the inflation of the seventies, annual equipment inventory values have soared from $320,000 in 1977 to $390,000 in 1980. This has increased the importance of the departmental machine shop which has been fully equipped and staffed by a full-time machinist since 1965. Economy necessitates the construction of many equipment items locally rather than purchasing, while some equipment must be fabricated in the shop because of unique design and application. In addition to construction, maintenance, and repair of equipment, the machinist also operates and maintains the cryogenic equipment. Two liquid nitrogen cryogenerators and a helium liquefier produce liquid nitrogen and liquid helium for low-temperature physics research. Liquid nitrogen is also made available to other departments.

Despite past funding and enrollment problems, the faculty of the department continue to be optimistic. Employment opportunities for physics graduates, at all levels, have improved dramatically in the last two years. Many more inquiries from prospective students, both undergraduate and graduate, are now being received by the department. A strong and enthusiastic staff, equipped with excellent facilities, is ready to provide them with sound learning opportunities in strong programs at the bachelor's, master's and doctorate levels.

FACULTY OF THE DEPARTMENT OF PHYSICS

(Rank of Instructor and Above)
University of North Dakota
1970-1982

1970-1971	Olen Kraus
	John L. Hundley (emeritus)
	Robert B. Witmer (emeritus)
	Harold D. Bale
	Henn H. Soonpaa
	Glenn I. Lykken
	Murray Muraskin
	B. Seshagiri Rao
	Tommy D. Clark
	James W. Harrell, Jr.
	Francis J. Howell
	Wilbur O. Weisser
	Duane R. Cole
1971-1973	Olen Kraus
	John L. Hundley (emeritus)
	Robert B. Witmer (emeritus) (deceased--February 1972)
	Harold D. Bale
	Henn H. Soonpaa
	Glenn I. Lykken
	Murray Muraskin
	B. Seshagiri Rao
	Wilbur O. Weisser
	Tommy D. Clark
	James W. Harrell, Jr.
	Francis L. Howell
	Duane R. Cole
1973-1974	Olen Kraus (on leave)
	Wilbur O. Weisser
	John L. Hundley (emeritus)
	Harold D. Bale
	Henn H. Soonpaa
	Tommy D. Clark
	Glenn I. Lykken
	Murray Muraskin
	B. Seshagiri Rao
	Duane R. Cole
	James W. Harrell, Jr.
	Francis L. Howell
	Michael L. Jones
1974-1975	Wilbur O. Weisser
	John L. Hundley (emeritus) (deceased--December 1975)
	Harold D. Bale
	Olen Kraus
	Murray Muraskin
	Henn H. Soonpaa
	Tommy D. Clark

	Francis L. Howell
	Glenn I. Lykken
	B. Seshagiri Rao
	Duane R. Cole
	James W. Harrell, Jr.
1975-76	Wilbur O. Weisser
	Harold D. Bale
	Olen Kraus
	Murray Muraskin
	Henn H. Soonpaa
	Tommy D. Clark
	James W. Harrell, Jr.
	Francis L. Howell
	Glenn I. Lykken
	B. Seshagiri Rao (on leave)
	Duane R. Cole
1976-1978	Wilbur O. Weisser
	Harold D. Bale (on leave--2nd semester 1977-1978)
	Olen Kraus
	Glenn I. Lykken
	Murray Muraskin
	Henn H. Soonpaa
	Tommy D. Clark
	James W. Harrell, Jr.
	Francis L. Howell
	B. Seshagiri Rao
	Duane R. Cole
1978-1980	Wilbur O. Weisser
	Harold D. Bale
	Olen Kraus
	Glenn I. Lykken
	Murray Muraskin
	B. Seshagiri Rao
	Henn H. Soonpaa
	Tommy D. Clark (on leave)
	James W. Harrell, Jr. (on leave)
	Francis L. Howell
	Duane R. Cole
1980-1981	Wilbur O. Weisser
	Harold D. Bale
	Olen Kraus
	Glenn I. Lykken
	Murray Muraskin
	B. Seshagiri Rao
	Henn H. Soonpaa
	Tommy D. Clark (on leave)
	Francis L. Howell
	Duane R. Cole
	William A. Schwalm
1981-1982	Wilbur O. Weisser
	Harold D. Bale
	Olen Kraus
	Glenn I. Lykken

Murray Muraskin
B. Seshagiri Rao
Henn H. Soonpaa
Duane R. Cole
Francis L. Howell
William A. Schwalm