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## Iowa Physics Through the Years

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## Iowa Physics Through the Years

LESTER T. EARLS<sup>1,2</sup>

The ensuing paragraphs will attempt to review the development of physics in Iowa from its early beginnings to the present. Since much of physics activity is and has been supported by institutions of higher education, the developments at the several colleges and universities will be pertinent to the story. But since physics is essentially a human activity, the persons who made major contributions to the development of Iowa physics must become a significant part of this review.

## THE EARLY YEARS

The first offerings of topics in physics antedate the organization of the Iowa Academy of Science by some two decades. In 1856, nine years after the legislative charter establishing The University of Iowa,<sup>3</sup> but only one year after the first actual classes were begun, a course in the "Department of Natural Philosophy" was available to students at Iowa City. Included were such physics topics as mechanics, hydraulics, electricity and magnetism, acoustics, optics, and meteorology. A \$500 appropriation had been made the preceding year for laboratory equipment in chemistry and physics. This early emphasis on laboratory instruction placed The University of Iowa among the leaders in the field, since in 1871 there were only about four institutions in the nation with a systematic plan for laboratory-type instruction; the Massachusetts Institute of Technology and The University of Iowa were among them.<sup>4</sup> Professor L. W. Andrews early served the University as Professor of Physics and Chemistry and Director of the Chemical Laboratory. In 1867 Gustavus Hinrichs published papers on the topic "Automechanics," and a few years later received international recognition for his development of student laboratory programs in physics. The first astronomical optical observatory at the University was built in 1874, and physics and astronomy became established as a separate department in 1887, with Professor A. A. Veblen as its first chairman (1887-1905).

At Iowa State University instruction in physics began very soon after college-level classes were initiated in 1869. W. A. Anthony was appointed Professor of Physics in 1872, but disagreement arose over compensation for summer employment for installing laboratory equipment, and there was further misunderstanding regarding opportunity for personal research. In his 1942 history of Iowa State, E. D. Ross remarks: "The consequence was the loss of a physicist of energy and creative mind."<sup>5</sup> Professor Anthony was replaced in 1873 by J. K. Macomber who also taught elocution and Shakespeare, and was librarian (!). He was one of a group

which took part in the formation of the Iowa Academy of Science in 1875. By 1887 the Iowa State University catalog listed two years of physics instruction for sophomores and juniors; the course content was closely tied to the needs of students in "Mechanics Arts" (i.e., engineering). The applied nature of the work led to early provision of laboratory facilities in light and sound, and an optional senior course in analytical mechanics offered "two afternoons per week" in the laboratory. Two years later the physics equipment was valued at \$8,000, a figure which would surely be much enhanced if expressed in 1975 dollars! By 1893 there were 17 physics courses listed, including the areas of astronomy and photography. The Department of Physics and Electrical Engineering had been established by 1890; Professor J. C. Hainer was involved in physics instruction, and Professor W. S. Franklin came a year later to be chairman of the department. In 1896-1897 Professor Franklin became the first member from the physics discipline to serve as president of the Academy.

At the University of Northern Iowa, a physics course was offered under the title "Natural Philosophy" in 1878. Diela Knight was in charge of "Natural and Physical Sciences and Gymnastics" (!), followed by A. C. Page (natural and physical sciences) in 1889 and L. Begeman in charge of physics in 1899. Professor Begeman remained on staff until 1935; as a graduate student at the University of Chicago, he had played an important role in the Millikan oil drop measurements of the fundamental charge on the electron.

In addition to the physics offerings at the three state schools, the pre-1900 period saw physics courses established in some 14 private Iowa colleges, including Coe College and Drake University (both initiating courses in 1881), Luther College in 1884, Simpson College in 1888, and Parsons College in 1889. The course content of most of these physics offerings would be regarded by present standards as rather limited; perhaps many present-day high school physics programs would eclipse the pre-1900 college offerings in both breadth of coverage and depth of intellectual demand. (In defense of the Iowa physics of that period, however, it should be said that the physics included in those college courses probably represented a far higher percentage of the then

<sup>3</sup> Several colleges and universities in Iowa have experienced one or more changes of name during their existence. In order to simplify references to these institutions, they have been designated by the use of their present (1975) names. Identification with past names may be assisted by the following information, in which the present name is followed in parentheses by earlier names:

The University of Iowa (State University of Iowa),  
Iowa State University (Iowa State College of Agriculture and  
Mechanic Arts, State College, Ames College),  
University of Northern Iowa (Iowa State Teachers College,  
Iowa State Normal School),  
Grinnell College (Iowa College).

<sup>4</sup> Almy, F. F. Progress of Physics in Iowa in the Quarter Century *Proc. Iowa Acad. Sci.*, Vol. 19: 73-77 (1912).

<sup>5</sup> Ross, E. D. History of Iowa State College, p. 93.

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<sup>2</sup> Dr. Earls became a member of the Academy in 1939. He has been Physics Section chairman, chairman of the Committee on Revision of Constitution and Bylaws (1968-69), vice-president (1963-64), and president (1964-65) of the Academy.

extant total physics knowledge than does the physics of our present first-year courses when compared to the present enormous body of technical information.)

Research interests, while necessarily subordinated to instructional duties in the early years, grew in importance as the start of the 20th century approached. Frank F. Almy (Grinnell) was taking X-ray pictures in early 1896, within a month or two after the discovery of this penetrating radiation by Roentgen. The first papers on physics topics presented to an Iowa Academy of Science meeting appear to have been in 1887 by L. W. Andrews (primarily a chemist): "On a New Astatic Galvanometer with a Spiral Needle," and by T. Proctor Hall (primarily a geologist): "Physical Theories of Gravitation." In 1899 the presidential address by W. S. Hendrixson (Chemistry Section) recognized the spectacular developments in physics which were to lead to the coming century of "modern physics" by devoting more than four pages to this field. Just after 1900 began a continuing series of papers by physicists: in 1901, A. A. Veblen (The University of Iowa) on "Relation of Physics to the Other Material Sciences" and "Some Improved Laboratory Devices and Apparatus," and W. M. Boehm (The University of Iowa) on "A Ruling Engine for Making Zone Plates"; in 1902, F. F. Almy (Grinnell) on "Observations on Action of Coherers When Subjected to Direct Electromotive Force."

#### THE MIDDLE YEARS

The first four decades of the 20th century saw a fulfillment of the earlier promises: development of physics departments to full stature and expansion of instructional activities. There was also growing interest in graduate level physics and gradual establishment of ongoing programs of graduate research at the two larger state institutions.

The University of Iowa was the first to offer graduate work in physics, beginning in 1900. The first recipient of a Master of Science degree was LeRoy D. Weld, with a thesis: "A Brief Elementary Treatise on Terrestrial Magnetism." (He then served Coe College as chairman until 1940, and was co-author of a widely used general textbook in physics for engineering students.) In 1909 George W. Stewart took over the chairmanship of the department from Karl Guthe, and in 1910 the first Doctor of Philosophy degree was granted to Lee Paul Sieg, who presented a dissertation on the topic "A Study of Some of the Elastic Properties of Platinum-Iridium Wire." Professor Stewart made many contributions in the field of acoustics and its applications. He is also well remembered for his "June Colloquium of College Physicists," initiated by him in 1936 and continued except for three World War II years until 1959. These annual meetings served mid-west physicists well as a gathering-place for discussion of both research and instructional topics. Until his death in 1956, Professor Stewart planned these meetings with continuing fresh points of view and topics. His genial spirit as he acted as host at each meeting pervaded the sessions with a recognition of the importance of each man's contribution to the field of physics, whether by innovative teaching or by an active research program. Professor Stewart served as president of the American Physical Society in 1942. He relinquished the departmental chairmanship to Louis A. Turner in 1946, but continued to be active in physics. The growing interest of the physics profession in nuclear research was re-

flected at the University in the building of a Cockcroft-Walton 400 KeV nuclear accelerator in 1937 under the leadership of Alexander Ellett.

Iowa State University began the 20th century with a combined department of physics and electrical engineering, headed by Professor Louis B. Spinney from 1897 until 1909, when separate departments were established. Professor Spinney continued as head of physics until 1930, and was active in the department until close to the time of his death in 1951 at the age of 81. He was known nationally for his general textbook of physics which went through five editions from 1911 to 1937, sold more than 100,000 copies, and was at one time used by 150 colleges and universities. Dr. Jay W. Woodrow became department head in 1930, after coming to Iowa State from the University of Colorado in 1921. He guided the department through the difficult wartime years, and retired from administrative work in 1947. He continued active in the department until his death in 1951. Growth in the undergraduate program in physics was matched by increasing emphasis on graduate work. The first Master of Science physics degree was granted in 1917 to Everett R. Colli; his thesis topic was "A Study of the Cooling Effect Due to the Peltier E.M.F." A total of 18 master's degrees preceded the first Doctor of Philosophy degree, which went to Robert M. Bowie in 1933. His dissertation was entitled "The Determination of the Thermionic Work Function of Nickel by a New Method"; the work was done under the direction of Gerald W. Fox. The growth in research activity at Iowa State University during the years preceding World War II is shown by the fact that from 1933 through 1940 21 Master of Science degrees in physics were awarded, and 20 Doctor of Philosophy degrees.

The emphasis on teacher training at the University of Northern Iowa delayed the formal entry into graduate physics work until the decade of the 1950's. However, a student, Eugene F. Grossman,<sup>6</sup> was actively interested in "wireless telegraphy" in 1916; his experimental apparatus made possible exchanges of messages between President Homer H. Seerley, of the (then) Iowa State Teachers College, and President Raymond A. Pearson, of (then) Iowa State College. President Pearson transmitted (via Grossman) ". . . I send greetings by wireless telegraph. The genius of the engineer may make it possible for us to talk by wireless telephone. . . ." Grossman made contributions to "wireless telephony" while at UNI, and later while with the American Telephone & Telegraph Company. He became operating engineer for the National Broadcasting Company when it came into existence in 1927. Among students at UNI who achieved national reputations in physics are listed: Robert D. Hutton, who became Deputy Director of the National Bureau of Standards; Harald C. Jensen, long-time physics teacher at Lake Forest College and recipient of the AAPT R. A. Millikan Lecture Award for 1974; and Leonard O. Olsen, professor of physics at Case until 1960, later with the U.S. Naval Postgraduate School, and president of the American Association of Physics Teachers, 1960-61.

<sup>6</sup> Grossman worked in collaboration with James O. Perrine, who was professor of physics at UNI from 1909 to 1916; the latter went on to a Ph.D. from Cornell University and a career with the American Telephone & Telegraph Company, serving as vice-president from 1939 to 1951.

During the first half of the 1900's, the private colleges of Iowa made many contributions to the developing field of physics and physicists. Physics departments were established at Coe College (1905), Luther College (1912), Drake University (1923), Parsons College (1924), and Westmar College (1950). During the 1920's and 1930's, Coe College, with Dr. Arthur Erskine, operated an X-ray laboratory, investigating radiation fields from X-ray tubes, filters, and absorption characteristics of materials.

At Drake University the department of physics and astronomy was guided from 1900 to 1922 by D. W. Morehouse (whose discovery in 1908 of a comet with unusual behavior attracted much attention among astronomers) and from 1923 to 1964 by Paul S. Helmick. Drake alumni of note are: Jay W. Woodrow ('07), selected to be a Rhodes scholar at Oxford, and later head of the physics department at Iowa State University; Seth B. Nicholson ('12), who served for more than 40 years as astronomer at the Mt. Wilson Observatory of the Carnegie Foundation; and Erling N. Jensen ('32), who spent about two decades at Iowa State University, becoming Professor of Physics and Senior Physicist in the Ames Laboratory of the Atomic Energy Commission, and nearly a decade as President of Muhlenberg College in Pennsylvania.

Physics at Grinnell received major early inspiration from Frank F. Almy, who came to the campus in 1893 and brought with him a background of work with Henry Rowland at Johns Hopkins involving the diffraction grating, and indirect contact with European work on the newly discovered electron and cathode rays. Almy's guidance incited O. E. Buckley ('09) to go on to Cornell University for his doctorate; he later became director of research at the Bell Telephone Laboratory, and from 1940 to 1951 he was president of AT&T. Samuel R. Williams ('01) made major contributions to the field of magnetism during his Ph.D. work at Columbia and his tenure at Oberlin (1908-1924) and Amherst (1924-1955). Grant O. Gale took over the headship of the physics department at Grinnell in the inauspicious depression year of 1933. In spite of financial limitations, the department engaged in research projects in radio circuitry and thermodynamics, and was prepared to make significant contributions to the army training program during the ensuing wartime years.

Among the several score of recipients of bachelor's degrees in physics at Luther College during the early portion of the 20th century were: M. H. Trytten ('16), long-time teacher at Luther College and at the University of Pittsburgh, and for more than a decade and a half Director of the Office of Scientific Personnel of the National Academy of Science; S. Legvold ('35), Professor of Physics at Iowa State University and Senior Physicist in the Ames Laboratory of the AEC, with many contributions to the knowledge of rare earth properties; and L. O. Herwig ('43), research scientist with the Westinghouse Electric Corporation and director of solar energy research work with the National Science Foundation.

#### THE WARTIME YEARS

The advent of World War II had an understandably significant effect on the Iowa physics community. The undergraduate teaching of physics was seriously disrupted by the draft of most males of student age, but the military services set up training programs for their officers and draftees. The University of Iowa, Iowa State University, Grinnell, and

other schools operated extensive specialized training classes which in many cases were somewhat comparable to the usual first-year college courses.

With the change in teaching emphasis came a marked drop in the graduate teaching and academic research programs. Figure 1 shows the paucity of graduate physics degrees granted by Iowa State University during the war years and those immediately following the war. But since World War II had a technological base far more extensive than any earlier war, Iowa physicists found themselves needed in research programs oriented toward military goals. Ballistics, electromagnetic radiation (in radar, infrared, and optical wavelength regions), underwater sound—all received significant research contributions from the Iowa physics community. Above all, however, the development of nuclear energy was the most spectacular; the Manhattan Project centered around physics, but was carried forward by cooperative efforts by physicists, chemists, mathematicians, and engineers. In 1942 the sudden demand for uranium metal of extreme purity and in unprecedented amounts led to the formation of a group at Iowa State University under the direction of Dr. F. H. Spedding. Physics and chemistry research merged to investigate the characteristics of uranium, plutonium, and other elements pertinent to the nuclear energy development. Much of the pure uranium used in the first nuclear reactor on the University of Chicago campus came from the ISU pilot plant. Though the production methods were later turned over to industrial corporations, ISU supplied directly to the Manhattan Project over two million pounds of highly purified uranium.

#### THE LATER YEARS

The close of the war freed many able physicists from these wartime duties and resulted in a phenomenal increase in available teachers of physics, undergraduates using their GI educational benefits, graduate students working toward graduate degrees, and able research personnel to man broadened research programs.

At The University of Iowa the postwar activity included the construction of a 4 MeV Van de Graaff accelerator with James Jacobs as principal investigator. Contributions were made in many fields of physics by J. A. Eldridge, M. B. Gottlieb, J. A. Jacobs, J. M. Jauch, J. Joseph, E. B. Nelson, W. R. Savage, F. Rohrlich, E. P. T. Tyndall, and others. In 1951 James A. Van Allen followed Louis Turner as head of the department, and almost immediately expressed his interest in physics research in space by initiating a program for sending instrument packages aloft by rockets launched from high-altitude balloons (so-called "rockoons"). With the advent of the national space vehicle activity it was possible to send instruments into orbits with apogee distances of several earth radii. These flights resulted in the discovery of the well-known Van Allen radiation belts. Extension of instrumented flights continued, with University of Iowa experimental packages riding with space probes to neighboring planets. The latest is Pioneer 11, which was launched in April, 1973. It passed close to the planet Jupiter in December, 1974, and is now on its way toward Saturn (predicted to arrive there in September, 1979). These flights have yielded much valuable information about planetary surface conditions, gravitational and magnetic fields, and solar wind conditions near our own and other planets. Accompanying this internationally known

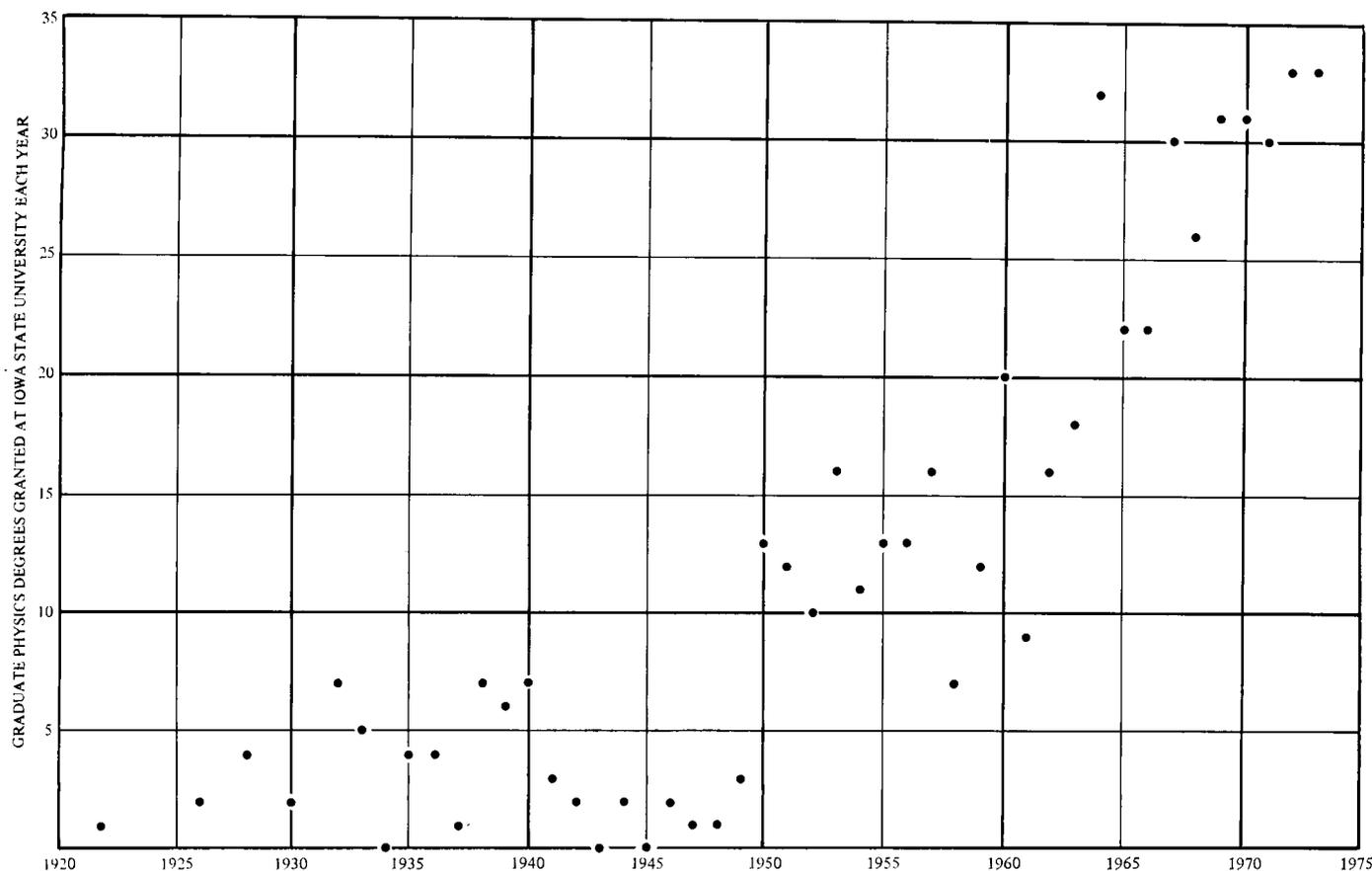


Figure 1. Graduate Physics Degrees Granted by Iowa State University, 1920-1973.

activity have been active research programs at The University of Iowa in other areas of astrophysics, in radio astronomy, solid state physics, plasma physics, nuclear physics, and other fields. In 1964 a new 6 MeV Van de Graaff accelerator was installed, and construction of the Hills Optical Observatory was completed in 1965. This was followed in 1968 by the completion of the North Liberty Radio Observatory and the installation of a 60-foot diameter dish antenna for radio reception of signals.

Postwar physics developments at Iowa State University involved an influx of physicists who had been engaged in wartime research programs. G. W. Fox, a member of the ISU staff since 1930, had spent the war years at the Radiation Laboratory of MIT and later was scientific adviser to General Douglas MacArthur in Japan. He was to return to ISU as department head in 1947, but during the preceding year or two he did active recruiting among his colleagues. His enthusiasm persuaded a number of research physicists to join the ISU staff. Among them were J. F. Carlson, G. C. Danielson, J. K. Knipp, and L. J. Laslett, all previous members of the staff of the Radiation Laboratory at the Massachusetts Institute of Technology; S. Legvold from the Naval Ordnance Laboratory; J. M. Keller from the Los Alamos laboratory, and P. G. Koontz from the Manhattan Project. These and others became part of the Institute for Atomic Research which was established as an administrative unit of the University in 1945.

The Institute was an outgrowth of the wartime services of the ISU Spedding group to the Manhattan Project. The Institute contracted with the Atomic Energy Commission to establish the Ames Laboratory of the AEC in 1947; this has become one of the several major national laboratories operated by the AEC. Academic appointments in the Physics Department were matched with research appointments in the Ames Laboratory, and the combination brought many research physicists to ISU during the following decades. Among those arriving in the 1950's were: R. G. Barnes (now department chairman), G. H. Bowen, B. C. Carlson, R. H. Good, C. L. Hammer, D. W. Lynch, C. A. Swenson, D. J. Zaffarano (department chairman, 1961-71, and now Vice President for Research and Dean of the Graduate College). These, and others through the 1960's, developed broadly based fundamental research programs in high energy and elementary particles, and solid state and nuclear physics. Astronomy and astrophysics began in the mid-60's under W. I. Beavers and others; the Fick Observatory, built in 1970, was a major addition to research facilities in this field.

The University of Northern Iowa moved into graduate level physics with the offering of a Master of Arts degree in "science with physics emphasis" in 1953, and an M.A. in physics in 1966. Under the direction of Roger J. Hanson, head of the Department of Physics since 1970, there has been growing emphasis on physics research to supplement the

long-time contributions of UNI to the training of teachers in physics and other areas of science.

Other Iowa colleges moved forward during the postwar decades in their physics programs. Dordt College, with Marvin DeYoung, and Westmar, with Sheldon Cram, instituted departmental status for physics in 1965 and in 1950, respectively. Drake University began graduate level work in physics in 1936; its physics department has been chaired by David Robinson since 1968. Earlier chairmen were D. W. Morehouse (1900-1922), Paul S. Helmick (1923-1964), and Russell V. Cochran (1964-1968). Grant O. Gale served Grinnell as physics chairman from 1933 for approximately a quarter of a century; later R. J. Hanson, B. E. Clotfelter, and others guided the physics activities there. The department at Luther College has had eight chairmen since its inception in 1912: O. B. Overn (1913-1920), M. H. Trytten (1920-1925), E. H. Hendrickson (1925-1927), O. M. Jordahl (1927-1931), H. E. Elligston (1931-1937), S. Legvold (1937-1939), E. C. Miller (1939-1972), and David T. Nelson (1972- ). When Parsons College closed its doors in 1973, its department chairman was Robert R. Meijer (1969-1973); he was preceded by Richard Nuckolls (1967-1968). Wartburg's long-time chairman, William Azbell (1952-1971), was followed by Donald Roiseland (1971-1974), and Millard Lee (1974- ). Westmar's only department chairman has been Sheldon L. Cram, who served from 1950 until 1974. Briarcliff, Central, Cornell, the University of Dubuque, Iowa Wesleyan, Loras, Morningside, Simpson, St. Ambrose, and Upper Iowa, as well as the several private two-year institutions and the more recently established area community colleges, have all contributed to the training of their students in physics.

It is estimated that the number of undergraduate students receiving physics instruction in Iowa has risen over the years from an estimated 100 in the late 1880's<sup>7</sup> to a present total

of about 8,000, of which nearly three-quarters are enrolled in the three state universities. In the graduate physics field, the growth of physics in Iowa in the 20th century is indicated by the data of Figure 1, where the number of graduate degrees granted each year by Iowa State University is shown from 1920 through 1973. It is interesting to note that more than half (54 percent) of the total of 539 degrees granted in the nearly half-century appear in the last 10 years of the period. Similar trends would appear in similar data from the University of Iowa research activities.

Memberships held by Iowa physicists in the American Physical Society grew from 81 in 1951 to 122 in 1965, and to 176 in 1970. An even greater percentage increase occurred in the American Association of Physics Teachers. In 1940 only 12 Iowans were members, but by 1970 there were 165 in the organization, and an active subgroup (Iowa Section, established in 1963 as a result of the enthusiasm of its first chairman, J. E. Dixon of ISU) holds regular semiannual meetings.

Space limitations unfortunately prevent the proper inclusion of the contributions to physics education in Iowa which have been made by the high schools of the state, and by the many able and enthusiastic high school teachers of physics. Any attempt to include names of school systems or of individual teachers would be patently inappropriate because of the omissions which would necessarily exist. Apology is expressly made to all such who have been thus unmentioned, as well as to the many others in educational institutions at all levels, and to those for whom physics has been an active hobby, whose contributions have not been listed here for want of space.

It is a pleasure to express appreciation to the many individuals across the state who have provided information regarding the progress of physics in Iowa within their purview. Their contributions have been invaluable in the preparation of this brief review.

<sup>7</sup> Almy, F. F. Progress of Physics in Iowa.