

Paul Bigelow Sears (1891-1990): Eminent Scholar, Ecologist and Conservationist

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ABSTRACT. Paul Bigelow Sears, botanist, ecologist and conservationist, was one of the most respected and honored ecologists in North America. He had the remarkable ability to explain complex environmental problems clearly and simply to colleagues, students and citizens. Sears devoted his life to furthering man's understanding of the delicately balanced ecosystems upon which mankind's very survival exists. The keenness of his mind, the warmth of his personality, the quality of his writing and his capacity to relate scientific problems to human affairs earned Professor Sears the distinction of an exemplary individual in American science. For his many accomplishments, he was the recipient of many honors and awards.

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EDUCATION AND PROFESSIONAL CAREER

Born 17 December 1891, in Bucyrus, OH, Paul Sears was the son of Rufus Victor and Sallie Jane (Harris) Sears. His father, a lawyer, was descended from Richard Sears who came from England to America on the third and final voyage of the Mayflower and settled in Plymouth, MA. Paul received his early education in the public schools of Bucyrus, graduating from its high school (1908). As a Phi Beta Kappa student, he earned the B.S. (1913) in zoology and the B.A. (1914) in economics from Ohio Wesleyan University, the M.A. (1915) from the University of Nebraska, and the Ph.D. (1922) *summa cum laude* in botany from the University of Chicago. His teaching career began as an instructor in botany at The Ohio State University (1915-June 1919), which was interrupted by military service in World War I (1917-Jan. 1919). He next became an assistant and associate professor of botany in the University of Nebraska (1919-27); professor and head of the Department of Botany at the University of Oklahoma (1927-38), serving also as botanist for the State Biological Survey of Oklahoma; and, while on sabbatical, a research associate at the Teachers College of Columbia University (1936-38).

Professor Sears returned to his home state as professor of botany and chairman of the Department of Botany at Oberlin College (1938-50). Then he was appointed professor of Conservation and Natural Resources and chairman of the newly established graduate-level master of science Conservation Program at Yale University, the first of its kind in the country. The program's aim was to give a limited number of qualified students, of various vocational interests and understandings, the basic principles of natural and social science involved in conservation. Sears held this professorship for 10 years (1950-60), and also served as chairman of the Department of Botany (1953-55) and the Yale Nature Preserve and then became emeritus professor (1960). Some 30 graduate students conducted studies dealing with the management of natural resources in various parts of the United States. Despite Sears' charisma and personal enthusiasm, and even though the Program attracted much attention and funding, administrative problems caused it to end when Sears retired. Because the Program had an environmental orientation, it was regarded by many as ahead of its time. Sears, himself, remained a staunch conservationist. In the 1960s, he served as a visiting professor at several colleges and universities, including the Tom Wallace Chair of Conservation at the University of Louisville. He remained active as a biological statesman, speaking and writing on mankind's stewardship of the earth's resources, until his death.

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EARLY RESEARCH EFFORTS

Sears had an active research and writing career throughout his life, publishing over 50 research papers in scientific journals, over 100 popular articles on ecology and conservation and 13 books. His research began as an undergraduate student during the summers of 1911 and 1914 at the Lake Laboratory of The Ohio State University, Cedar Point, OH. His first research paper, influenced by the prodigiously learned Herbert Osborn, was "The insect galls of Cedar Point and vicinity," published in the *Ohio Naturalist* (Sears 1914). It was followed by "Evaporation and plant zones in the Cedar Point marsh," in *The Ohio Journal of Science* (Sears 1916a). In his "little cubby-hole" office, but convenient workroom on the second floor of the B & Z Building on The Ohio State University campus, Sears studied the cytology of *Taraxacum officinale* (Dandelion) (Sears 1916b). This investigation, suggested by Charles E. Bessey, began in 1914 and was influenced early by his highly respected colleague and friend, Professor John H. Schaffner. The work continued during the next 8 years and resulted in several preliminary published papers (Sears 1917 and 1921a); his doctoral dissertation, entitled "Variations in cytology and gross morphology of *Taraxacum*," at the University of Chicago (1922), and its publication in two parts in the *Botanical Gazette* (Sears 1922a and b). Although he did not continue cytological research following these publications on the dandelion he (Sears 1922c) published an article in the *Botanical Gazette* on anthocyanin pigments.

MAPPING OHIO'S NATURAL VEGETATION

Sears' interest in Ohio's natural vegetation began early in life. As a lad growing up in northern Ohio, curiosity about plants, especially prairie plants, was piqued by stories Sears' father told of his own youthful days. Many stories were based on a family trip westward in a covered-wagon that crossed the unfenced tallgrass country to visit cousins in Nebraska. As interest in plant life increased, Sears noticed that the roadside plants south of Bucyrus, of which many belonged to the prairie flora, were quite different from those north of town. The prairie plants grew on the farms of the Killdeer Plains between Bucyrus, Marion and Upper Sandusky. In the history books of this area, Sears read of Colonel William Crawford being ambushed by Indians hiding in the tallgrass on the lower terrain, and about where oak and hickory occupied the drier knolls (Sears 1981).

While an instructor at The Ohio State University, it was Professor Edgar N. Transeau who influenced Sears to expand on his interest in prairie plants of the Killdeer Plains and the natural vegetation throughout Ohio. Transeau, who had arrived in the Department of Botany in 1915, the same year as Sears, had a

strong interest in relating the distribution of vegetation to climatic factors and in mapping the natural vegetation of the landscape. Beginning in 1919, Sears studied botanical information that could be derived from records made by federal land surveyors after the Northwest Territory was opened to European settlement in 1786. The surveyors divided the relatively level land into square-mile sections and, at or near each corner or "mile post," they noted the location of the most prominent or "witness" trees. Witness trees plotted on a map could be used to determine the distribution of various species of trees from which could be inferred the natural forest vegetation of the region before the onslaught of destruction by European settlers. Sears was truly a pioneer in developing techniques for the mapping of natural vegetation. His first paper on "vegetation mapping" (Sears 1921b), discussed methods of mapping and employed a set of symbols that he created to use in the making of maps. He also proclaimed the use of the airplane in reconnaissance mapping (Sears 1920).

Sears was the first to publish a map of the virgin forest of Ohio (Sears 1925). The various forest types were shown on the map: oak (circles), beech (plus signs) and ash (times signs). In the same publication were maps that depicted the relationship of oak and beech forest to the moraines; and, the natural treeless areas of Ohio and their correlation with moraines, preglacial drainage routes and postglacial lakes. In 1923, Sears had drawn a map of the virgin forest of Ohio using horizontal, vertical and slanting lines to show the extent of different forest types. This map, shown in 1923 at an AAAS meeting in Cincinnati, is not known to have been published by him until 1941 (Sears 1941); earlier it had been printed by E. Lucy Braun (Braun 1926). On Sears' map, she outlined the physiographic provinces of Ohio in an attempt to show a correlation between virgin forests and the physiography. Following these pioneer mapping contributions by Sears, the mapping of the natural vegetation of Ohio was continued by Professor Transeau and his students. The final product was a 35" x 38" [88.9 cm x 96.5 cm], eight-colored comprehensive map showing nine regional natural vegetation types (Gordon 1966), accompanied by a technical bulletin, "The Natural Vegetation of Ohio in Pioneer Days" (Gordon 1969), both prepared by Transeau's student, Robert B. Gordon.

RECONSTRUCTING POSTGLACIAL VEGETATION AND CLIMATE

Sears wanted to test Henry A. Gleason's suggestion that the western prairies farther east in Indiana and Ohio might be relics of a postglacial climatic period that was warmer and drier than the present (Gleason 1923). The opportunity came in 1925 when he and undergraduate Charles Olmsted, both then at the University of Nebraska, spent the summer at the University of Iowa Lakeside Laboratory on the shore of Lake Okoboji. While reading papers in the Laboratory's excellent library, Sears became aware of the work, begun about 1915, of the Scandinavians. They reported that the windblown pollen preserved in the sediments of lakes and bogs in the glaciated region is a reliable record of plants that once lived there. This information could be used as an indicator of former vegetation and climate, and was believed by Sears to be a means of providing evidence for Gleason's idea of an eastward prairie shift (Sears 1981). In the mud from the bottom of Lake Okoboji, pollen grains were found; and, an effort began to identify them.

Sears chose bogs in Ohio to obtain pollen samples in an attempt to trace the general course of vegetational changes in the Middle West. The New Haven bog, Huron Co., Ohio, was the first one

from which a pollen core was taken. Sears' student, Phyllis Draper at the University of Oklahoma, prepared the first paper on pollen analysis from Sears' Laboratory. Later, Sears wrote that her paper was the first on the subject to be published in the United States (Sears 1951). She explained the technique of pollen analysis and showed graphically the fluctuations in the percentages of grass and tree pollen at various depths in the New Haven Bog (Draper 1928). Her summary statement was "that at the present time results are too incomplete to permit the drawing of any conclusions" (Sears 1928). The following year in the same journal, Draper compared the pollen spectra of two bogs, the New Haven Bog and the Curtis Bog, Lucas Co. (Draper 1929), using peat samples obtained earlier by Sears. The paper described the vegetation types dominant at various depths in both bogs, but no correlations were made with climatic conditions, although that possibility was suggested in the introduction. Elsewhere in North America, two simultaneous studies on pollen-analysis were conducted during 1926 on peat deposits of southeastern Canada by Vaino Auer (Auer 1930) and in the Dismal Swamp, VA, by I. F. Lewis and E. D. Cocke (Lewis and Cocke 1929). Sears wrote that both studies showed extreme caution in drawing deductions about climatic conditions (Sears 1930a).

In 1930, Sears published two papers of major significance in the newly developing field of pollen analysis. He discussed the procedures in the technique of pollen analysis, and wrote keys and prepared line illustrations for the identification of 39 different kinds of common pollen grains preserved in the bog-lakes of the Lake Erie drainage basin (Sears 1930b). In the absence of any comprehensive manuals showing pollen structure, this paper was of importance because of its intent to assist in identification of the common pollen embalmed in bog deposits in the north-central United States. It was the bog near Sears' home, southeast of Bucyrus, where he obtained four cores of pollen, preserved there during postglacial time. Sears' analysis of the tree pollen obtained from the Bucyrus Bog resulted in his now historically significant paper, "A record of postglacial climate in northern Ohio" (Sears 1930a). In this paper, Sears traced in greater detail than any previous North American study, the probable succession in the postglacial forest vegetation, and inferred the accompanying changing climatic conditions for north-central Ohio since the retreat of the Wisconsinian glacier. Sears' paper has since become the benchmark, classic paper in this discipline in North America. The site has been restudied twice, in 1958 by Sears and Johannes Iverson, the eminent European palynologist (unpublished), and in 1986-88 by Linda Shane (Shane 1989).

For the 20± year period, while on the faculty of the University of Oklahoma and Oberlin College, Sears and his students studied other bog-lakes in northern Ohio, as well as stimulating other students and colleagues to engage in this kind of study. As a result, Sears sharpened the historical picture of Postglacial vegetation and climate in both glaciated and non-glaciated regions of eastern North America. The pattern obtained, closely paralleling that in Europe, includes conditions warmer and drier than at present, thus explaining relics of western vegetation in mid-eastern United States, as had been suggested by Gleason (1923). Although several investigators began the study of pollen from North American bog-lakes in the late 1920s, it was Paul Bigelow Sears who pioneered in the methodology, pollen identification, and interpretation of this new information. Sears was an undisputed leader in this research effort in North America until the beginning of the 1960s, when his publications nearly ceased on this subject.

As the author of the chapter on Plant Ecology in Joseph Ewan's

"A Short History of Botany in the United States" (Sears 1969), Sears modestly wrote of his own contribution to the field:

In 1930, fifteen years after the appearance of von Post's technique of using pollen to interpret changes in vegetation and climate, active use of this method began in the United States. Gleason's postulates were confirmed and general agreement between the European and American sequences was demonstrated. Applications to archaeology and cultural history followed, with notable contributions in the arid Southwest and in Mexico, far beyond the limits of continental glaciation.

CONSERVATION EFFORTS IN OHIO

Sears' major contribution to conservation was through his intellectual approach of teaching and writing to make people aware of the stewardship of the earth's natural resources. In this effort, he became a most distinguished spokesperson who had a wide influence on the entire conservation movement in North America. Sears' pioneer work on the natural and changing vegetation of Ohio led to a deep interest in human ecology which became manifest while at the University of Oklahoma during the tragic dust storms of the early 1930s. There he saw how the climate affected the soils and vegetation in this newly developed agricultural area, and from this scene came "Deserts on the March" (Sears 1935), his most successful book on conservation awareness. In 1937 Sears was chairman of the committee that drafted the first soil conservation district law in Oklahoma, and for several years after, he served as a collaborator in the U.S. Department of Agriculture.

After Sears came to Oberlin College in 1938, and during the decade to follow, he wrote on conservation topics relating to Ohio. He was invited to prepare a "History of Conservation in Ohio" (Sears 1942), a 22-page landmark publication that traced the enactment of laws governing the use of the natural resources and their awareness in conservation practices in Ohio. Those resources discussed were vegetation, wildlife, water, fish, minerals and soil. Sears' idea of conservation meant "prudent and skillful use of resources to obtain the maximum good for the longest possible time. Ideally it produces a permanently balanced relation between a human group and its environment. The factors involved are quantity and quality of resources, population and pattern of living. Follow-up contributions to Ohio conservation history appeared under the titles, "Man and Nature in Modern Ohio" (Sears 1946) and "Ohio's Conservation Record 1908-1958" (Sears 1958).

At meetings of The Ohio Academy of Science, Sears contributed papers on the landscape, natural resources, human population and conservation legislation in Ohio. In his Academy presidential address, "Conservation in Theory and Practice" (Sears 1950), Sears described examples of success and failure of man's interaction with the landscape. It is the scientist, with his wide understanding of the principles of sound land use, who must enlighten those who formulate public opinion and establish the standards of social behavior. His final statement then was; "The conservation movement may have a long and difficult way ahead, but it has crossed the divide." As a member of the Ohio Wildlife Council, established in 1944, Sears believed the Council's role was "to encourage better practices of land and water use within the State. Fish and wildlife will be restored only as fast as we restore suitable living conditions for them" (Sears 1946).

As a lasting tribute, Sears was inducted into the Ohio Conservation Hall of Fame, 24 April 1979, when he was recognized

"for his outstanding contributions to the importance of a better understanding of natural systems." Through his teachings, writings and lectures, he has instilled in generations of Ohioans a greater awareness of the delicate relationships between human ecology and the world of plants. His tireless enthusiasm and his concern with conservation problems have distinguished him as a leader in efforts to interpret better the natural world. His success in these endeavors is an inspiration for others to share in this quest for knowledge.

HONORS, MEMBERSHIP AND LEADERSHIP, BOOKS, PRESERVES AND FAMILY

Professor Sears was a member of many national scientific societies and received a number of honors and awards. A selected list follows.

Membership and Leadership

- American Academy of Arts and Sciences
- American Association for the Advancement of Science (president, 1956)
- American Society of Naturalists (president, 1959)
- Atomic Energy of the United States (advisory committee on its peaceful use)
- Book of the Month Fellowship Prize (for *Deserts on the March*, 1936)
- Botanical Society of America (Certificate of Merit, 1956)
- Connecticut Academy of Arts and Sciences
- Crawford County National Bank of Bucyrus, OH (director, 1942-63)
- Ecological Society of America (vice-president, 1943; president, 1948; eminent ecologist award, 1965)
- Garden Club of America (medal, 1963)
- Guggenheim Memorial Fellowship to study Pleistocene vegetation and climate in North America (1958)
- Louis Bromfield medal, Friends of the Land (1958)
- National Audubon Society (chairman of the board and honorary president, 1956-59)
- National Committee for the Development of Scientists and Engineers
- National Research Council of the National Academy of Sciences (committee on paleobotany; crop ecology; vegetation analysis; use and care of natural resources; conservation, chairman).
- National Science Foundation Board (1958-64)
- The Ohio Academy of Science (member, 1915; affiliated with the plant sciences section; fellow, 1921; member, Conservation Committee; president, 1949-50; honorary life member, 1964)
- Ohio Conservation Hall of Fame (1979)
- The Ohio State University (Centennial Achievement Award, 1970)
- Ohio Wesleyan University (distinguished achievement citation, 1980; recipient of the Godman Cane honoring the University's oldest living alumnus, 1989)
- Ohio Wildlife Council (1944-52)
- Pacific Botanical Garden (trustee, 1963-71)
- Richard Prentice Ettinger Medal (for skilled science writing in the popular style, resulting from his book, "Where There Is Life," the award given by the Rockefeller Institute, 1963)
- Sigma Xi (national lecturer, 1956)
- Society of Natural History of Mexico
- Southern Methodist University (citation for work in anthropology and geology, 1981)

Virginia-Carolina Chemical Corporation, Richmond, VA (director, 1956-60)
Who's Who in America (first listed, 1934)

Honorary Societies

Sigma Gamma Epsilon, Phi Sigma, Sigma Xi, Phi Beta Kappa and Delta Tau Delta

Honorary Degrees

D.Sc. (1937) Ohio Wesleyan University
D.Sc. (1958) Oberlin College
D.Sc. (1968) Bowling Green State University
Litt.D. (1951) Marietta College
L.L.D. (1957) University of Arkansas and University of Nebraska
L.L.D. (1959) Wayne State University

Books by Sears

Dates in parentheses of only those editions or printings that have been verified.

Deserts on the March (1935, 1947, 1959, 1964, 1980 and 1988)
This is Our World (1937, 1971)
Life and Environment (1939)
Who Are These Americans? (1939, 1940)
This Useful World (1941, with I. James Quillen and P. R. Hanna)
Charles Darwin: The Naturalist as a Cultural Force (1950)
The Ecology of Man (1957)
Where There Is Life (1962, 1970)
The Living Landscape (1966, an expanded version of *Where There Is Life*)
The Biology of the Living Landscape (1964)
Lands Beyond the Forest (1969)
Wild Wealth (1971, with M. R. Becker and F. J. Poetker)

Memorial

The 98.6 acre Sears Woods State Nature Preserve is a permanent natural memorial to Paul Sears. Located southwest of Bucyrus along the Sandusky River in Bucyrus Twp., Crawford Co., this land was owned by the Sears family since 1870, and was purchased from Paul Sears in 1986 by the Ohio Department of Natural Resources, Division of Natural Areas and Preserves. The site contains a beech-maple woods and swamp forest, considered to be equal in ecological quality to the Hueston Woods (Butler Co.) and Fowler Woods (Richland Co.) State Nature Preserves in Ohio.

Epilogue

During retirement, Paul Sears lived in Taos, NM, where he died 30 April 1990, in his 99th year. In Franklin, VA, 22 June 1917, Sears married Marjorie Lee McCutcheon of Modest Town, VA. A 1914 graduate of Denison University, she was a graduate student in English at The Ohio State University where they met in 1916. Three children were born to the Sears couple; Paul McCutcheon Sears (deceased), Dr. Catherine Louise (Sears) Frazer, and Sallie Harris Sears. Mrs. Sears' death occurred 31 October 1982, and afterward he married Mrs. Marguerite Saxer.

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