

Henry Chandler Cowles

1869–1939

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Recognized as a pioneer in developing the dynamic view of the biological landscape, Henry Cowles was also a key figure in the development of the field of ecology, and was widely liked and respected by biologists, geologists, and geographers. Cowles' major scientific contributions were two papers published in the *Botanical Gazette* in 1899 and 1901. In them, he eloquently described the spatiotemporal linkage between the processes of ecological succession, geomorphology, and climate change. His most elaborate achievement was in deciphering the interaction of geomorphological process and biological succession. Above all, however, Cowles was a great teacher who inspired a large proportion of the first modern generation of American plant ecologists and geographers.

1. EDUCATION, LIFE AND WORK

Henry Chandler Cowles, the elder of the two sons of Henry Martyn and Eliza (Whittlesey) Cowles, was born on 27 February 1869 in Kensington, Connecticut, USA. After graduating from the high school at New Britain, Connecticut, Cowles entered Oberlin College, and received the A.B. degree in 1893. In 1894 he taught Natural Science at Gates College, Nebraska, but in the following year he was given a fellowship to study in the Geology Department at the newly formed University of Chicago. There he studied with T.C. Chamberlin but, following a failed attempt to find and study what later proved to be a nonexistent geological formation in the western United States,

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Cowles shifted his emphasis to botany, and eventually completed his doctorate (1898) in the Botany Department under J.M. Coulter.

Cowles remained at Chicago, teaching courses in plant ecology, until his retirement in 1934. He advanced steadily in rank to Professor in 1915 and succeeded Coulter as Chairman of the Botany Department in 1925, a position he held until his retirement. Cowles lectured on a variety of topics, but taught several courses consistently throughout his career. These included Physiographic Ecology, Ecological Anatomy, Geographical Botany, Experimental Ecology, Applied Ecology, and Field Ecology. Cowles was known locally as a supporter of efforts in conservation and preservation, and was one of the principal supporters of the fight to save the Indiana dunes. During his career Cowles participated in many organizations and received numerous honours and awards. He was revered nationally and internationally for his contributions to ecology, and following his death on 12 September 1939 his significance in the physiographic study of the American environment, a vital contribution to geographical research, was splendidly shown in a memorial article by C.C. Adams and G.D. Fuller (*Ann. Assoc. Am. Geogr.* vol 30 (1940), 39-43). Like others, these authors regret that he did not publish his researches more abundantly.

2. SCIENTIFIC IDEAS AND GEOGRAPHICAL THOUGHT

Cowles' dissertation research, published under the title 'The ecological relations of the vegetation of the sand

dunes of Lake Michigan' (*Bot. Gaz.*, 1899), and his study of the interrelationship between geomorphic processes and ecological succession in 'The physiographic ecology of Chicago and vicinity' (*Bot. Gaz.*, 1901), became instant classics among early contributions to ecology. Cowles' work was inspired by European developments in ecology, particularly through the textbook and separately published sand dune succession studies of E. Warming. Cowles was well qualified to advance the work of Warming. Because of his original intention to become a geologist he spent the summer of 1895 in the field working for the U.S. Geological Survey, and subsequently extended his undergraduate training in geology through graduate studies at the University of Chicago. With his additional training in botany, Cowles undertook his dissertation research with the unique ability to perceive the linkages between physical and biological landscape processes.

Cowles' 1899 and 1901 works provide exceptionally clear expositions of the geomorphological and biological interactions involved in the various phases of succession. Throughout his analysis of succession on the dunes, Cowles described the positive interaction of plants and dunes in which each may alternately control the character of the other. His chief contribution in these works was his elucidation of the various ways in which physiographic processes control biological ones. Cowles saw topographical change as a predictable, directional process of denudation, deposition and, in the absence of crustal deformation, planation to base level. Despite Cowles' contributions to a synthesis of geomorphological and biological processes, relatively few attempts have been made to expand his work during the intervening eighty-five years.

Cowles' work led him to devise a general classification of succession based on clearly distinct causes: chorographic (due to climatic change), physiographic (due to geomorphological processes), and biotic (due to the interactions of organisms). He considered the first two to be principally of interest to physical geographers because of the greater variety of changes involved and the greater potential for experimental control in their study. He considered the potential for control to be due largely to the rapidity with which the biological processes operated, making it possible to study them directly during the span of a human lifetime. 'If in their operation, chorographic agencies are matters of eons, and physiographic agencies matters of centuries, biotic agencies may be expressed in terms of decades' (*Ann. Assoc. Am. Geogr.*, vol. 1/1 (1911), 1-20). Although Cowles' major contributions were in the area of physiography, he acknowledged that the character of current vegetation was largely due to biotic processes and that biotic processes in turn influence physiography. His classification of succession was criticized, however, because its emphasis on directional causality tends to lead to a de-emphasis of biological interactions and the feedback effects of biological or geomorphological processes.

The significance of Cowles' work is often evaluated by comparing it to the work of F.E. Clements (1874-1945), a graduate of the University of Nebraska

(Ph.D. 1898), and a major contributor to the formation and development of ecology. Tobey (*Saving the Prairies*, 1981) discusses the differing viewpoints of Cowles and Clements at length and concludes that they were part of a more general competition between the Nebraska and Chicago schools for leadership of the new field of ecology. Tobey traces the differences from Humboldt through Grisebach and Drude to Nebraska, and from de Candolle through Darwin and Warming to Chicago, and emphasizes the contrasting philosophical traditions behind the two schools. According to Tobey (*Saving the Prairies*, 1981, p. 99), Cowles' work represented a legacy of the mechanistic tradition in plant ecology stemming from de Candolle, whose emphasis on the individual plant as a mechanism responding to external stimuli was a departure from Humboldt's concept of broad vegetation groups responding cooperatively as integrated units. Clements integrated parts of both traditions, retaining the holistic formation concept originated by Humboldt and passed on through Grisebach and Drude.

It is true that Cowles disagreed with Clements' holistic concept of succession. Clements viewed the biological landscape as composed of complex organisms formed by groups of interacting and interdependent species that, like the cycle of landscape evolution suggested by W.M. Davis, developed irreversibly from youth to maturity. In his review of Clements' masterpiece *Plant Succession; An Analysis of the Development of Vegetation* (1916), Cowles comments that 'Clements states positively that "succession is inherently and inevitably progressive". This reviewer is as positive in his opinion as ever that succession may be retrogressive as well as progressive, ...' (*Bot. Gaz.*, vol 68 (1920), 478). According to Tobey this viewpoint of Cowles was derived from Warming for

Warming had made it clear in both the 1896 and 1909 editions [of his textbook] that vegetational development was not directional and was not irreversible, both fundamental tenets of Clements' successional theory, and part of the reason that other English-speaking scientists, such as Cowles, spoke of vegetation as developing when they did not wish to endorse Clements' successionalism (*Saving the Prairies*, 1981, p. 104).

Despite some disagreements relations between the two men never deteriorated to attacks in the literature.

For several reasons the competition involving Cowles and Clements probably had little influence on the contributions they made. First, it seems likely that Clements faced stronger opposition elsewhere than he did from Cowles. After 1901 Cowles published very little more than short commentaries and reviews, and when these involved Clements' work they were largely positive. The few disagreements were based on reasoned arguments. Clements, on the other hand, published prolifically, including several major works after 1901. The principal critics of his works, when such existed, were as apt to be European as American, and they were not at Chicago. P.B. Sears (*Fifty Years of Botany*, 1958) suggests that both men were stimulated by the cool reception they received from other biologists for their efforts to introduce a new discipline.

The tracing of separate schools of thought to Chicago and Nebraska provides an appealing synthesis, but its influence on the work of Cowles and Clements might be overemphasized. Although the conclusion in Tobey's *Saving the Prairies* (1981, pp.99-109) that Darwin's focus on the individual organism in his explanation of evolution led to Cowles' acceptance of the biological landscape as occupied by individual species rather than multi-species organisms seems reasonable, it is clear that Cowles was influenced more by Lamarck's definition of evolution than Darwin's. At several places in his dissertation Cowles states his intention to expand his studies of the plant ecology of the dunes with experimental analyses of the possible existence of acquired traits within the dune species. Cowles never carried out his experiments, and though he remained concerned with evolution he appears to have never fully understood Darwin's ideas.

Cowles' principal error in understanding Darwinian evolution appears to have been his misinterpretation that selection worked principally on species rather than on the traits of individuals (*Am. Nat.* vol 43 (1909), 361-2). This mistake, coupled with his low regard for jargon and teleological argument, led him to suggest abandoning the idea of adaptation and natural selection altogether. This view was strongly evident in his ecology text (*Ecology*, 1911), and was sharply criticized by Ganong (*Bot. Gaz.* vol 54 (1913)).

In many ways, however, Cowles' ideas closely corresponded to contemporary views on many subjects. He was repelled by the overly zealous efforts made by some to fit ecological justifications to morphological characteristics to the extent that it appeared that plants 'adapted' themselves consciously to features of the environment. At times it appeared that altruistic co-evolution of plants and animals was universal, and Cowles believed that as this was impossible to test, it was simply a teleological proposition. He doubted that all morphological features could be responses to the environment, and he called on ecologists to keep in mind that perfect adaptation was an illogical proposition simply because of the evidence that many species had become extinct in the past (*Am. Nat.* vol 43 (1909)).

3. INFLUENCE AND SPREAD OF IDEAS

By extending earlier work in Europe while simultaneously pioneering in a new American field of science, Cowles was assured of wide interest in his ideas. His personal relationships with leaders in the fields of geology and biology further facilitated the spread of ideas into other disciplines.

Cowles was not a prolific writer, but his long association, begun while a graduate student, as reviewer and editor of the *Botanical Gazette* provided opportunities for expressing his ideas. Cowles' reviews of ecological and botanical literature, frequently containing his own views on a wide variety of subjects, numbered literally in the hundreds. His close ties with the *Gazette* continued for thirty-six years until his retirement as editor in 1935.

Cowles' influence was also felt through his involvement in professional organizations. He was a member of the Committee on Organization which met in 1904 to found the Association of American Geographers under the chairmanship of W.M. Davis, and from 1904-08 was one of the three councillors who then formed its Council with a president, two vice-presidents, a secretary and a treasurer. In 1910 he served as President. He was similarly active in the Ecological Society of America, of which he became President in 1917. Cowles was vice-president of Section G of the American Association for the Advancement of Science in 1913, President of the Botanical Society of America and President of the section on Phytogeography and Ecology of the International Botanical Congress in 1930. Cowles also served as president of the Chicago Academy of Science and the Geographic Society of Chicago.

Though best known for his early crucial publication on succession, Cowles also influenced the development of American plant ecology through his teaching. He usually taught seven or eight courses per year, including extensive summer field classes composed of students, in-service teachers, and colleagues. Cowles' knowledge of plants and geological formations, coupled with his enthusiasm and warm personality, served to inspire those who accompanied him on his many field trips with greater appreciation and concern for natural processes. As an effective teacher, pioneering in a new field, Cowles' ideas and approach to ecology reached a large proportion of the first generation of American ecologists.

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Chronology

- 1869 Born at Kensington, Connecticut, 27 February
- 1893 A.B. from Oberlin College
- 1894 Taught natural science at Gates College
- 1895 Given fellowship at University of Chicago
- 1897 Appointed Teaching Assistant in the Botany Department at University of Chicago; began extended summer field studies with students and colleagues that included most North American habitats, and continued yearly throughout most of his career
- 1898 Ph.D., University of Chicago
- 1899 'The ecological relations of the vegetation of the sand dunes of Lake Michigan'
- 1900 Married Elizabeth Waller
- 1901 'The Physiographic Ecology of Chicago and Vicinity'
- 1902 Appointed Instructor of Botany at University of Chicago; *Journal of Geography* formed with Cowles as phytogeography head
- 1904 Used the U.S. Subtropical Laboratory at Miami as a base of operations while studying the Florida Everglades
- 1905 Appointed first secretary/treasurer of newly formed 'Botanists of the Central States', American Association for the Advancement of Science delegate, with

- Coulter and Shear, to the International Botanical Congress in Vienna
- 1906 Spent the autumn and winter in Florida, studying the Everglades under a grant from the Carnegie Foundation
- 1907 Appointed Assistant Professor
- 1910 President of the Association of American Geographers
- 1911 *Chicago Text Book of Botany*; promoted to Associate Professor
- 1913 Vice President of Section G of the American Association for the Advancement of Science; led the International Botanical Congress tour of United States
- 1914 Participated in the formation of the Ecological Society of America
- 1915 Professor of Botany, University of Chicago
- 1917 President of the Ecological Society of America
- 1922 President of the Botanical Society of America
- 1923 Oberlin College conferred the honorary Sc.D. degree
- 1925 Succeeded Coulter as chairman of the Botany Department
- 1926 Editor of the *Botanical Gazette*
- 1930 President of the section on phyto-geography and ecology of the International Botanical Congress
- 1934 Honorary lifetime membership in British Ecological Society; retired as Professor Emeritus
- 1939 Died in Chicago, 12 September