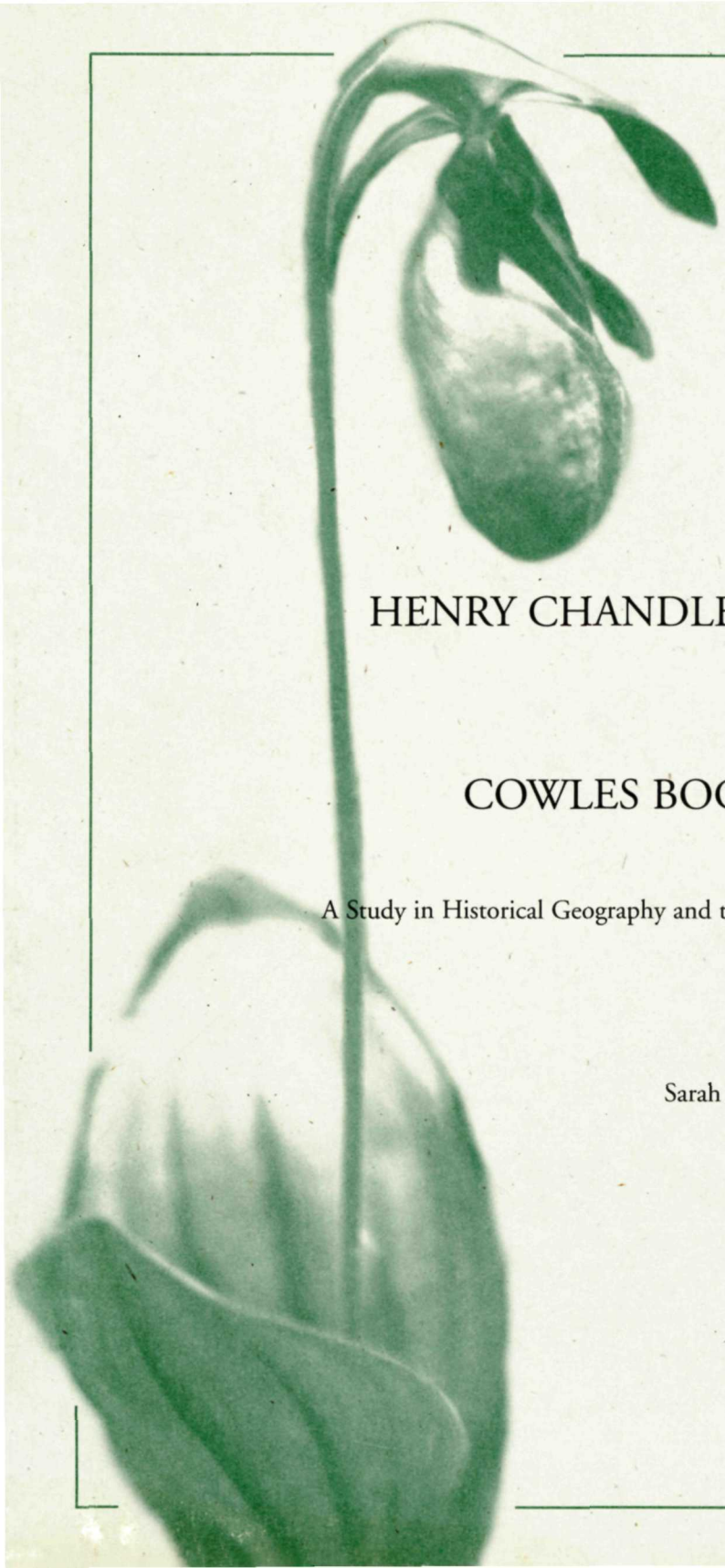

HENRY CHANDLER COWLES
(1869-1939)

AND

COWLES BOG, INDIANA

A Study in Historical Geography and the History of Ecology

by
Sarah Gibbard Cook, Ph.D.

front cover image: *Cypripedium acaule* (Pink Lady's Slipper), Mineral Springs, Indiana, 30 May, 1913. Image extracted from glass negative by George Damon Fuller, aep-inn110.

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for
The Indiana Dunes National Lakeshore
National Park Service
U. S. Department of the Interior

in cooperation with
Great Lakes Heritage, Inc.
Chicago

1980
revised 1999

The Field Museum

INDIANA DUNES
NATIONAL LAKESHORE

HENRY CHANDLER COWLES (1869-1939) AND COWLES BOG, INDIANA, A Study in Historical Geography and the History of Ecology by Sarah Gibbard Cook, Ph.D. Manuscript originally prepared for The Indiana Dunes National Lakeshore, National Park Service, U. S. Department of the Interior in cooperation with Great Lakes Heritage, Inc. Chicago 1980. Revised 1999.

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Founded in 1981, in memory of Dr. Shirley Heinze,
to maintain and expand upon nature's beauty in the Indiana Dunes.

Sarah Gibbard Cook studied history at Oberlin College (B.A.) and Harvard University (M.A., Ph.D.). After a post-doctoral year in African Studies at Kent State and a visiting faculty appointment at the University of Chicago, she collaborated with Robert S. Jackson to write The Bailly Area of Porter County, Indiana (Evanston: Robert Jackson & Associates, 1978) for the Indiana Dunes National Lakeshore. IDNL staff then asked her to research Henry Chandler Cowles and his relation to Cowles Bog.

Cook was a researcher and assistant editor in the geography department of Encyclopaedia Britannica and then managed international humanitarian programs for The Rotary Foundation of Rotary International. She is now an independent historian and writer based in DeForest, Wisconsin.

Preface

by Noel B. Pavlovic, Ph.D.

In the mid 1980s, I discovered Sarah Gibbard Cook's manuscript in the files of the Indiana Dunes National Lakeshore Science Division. I felt it was worth publishing as a testimony to Henry Chandler Cowles and his significance to the field of ecology. It is also a tribute to his namesake natural area, Cowles Bog at the Indiana Dunes National Lakeshore. Ron Engel, author of "Sacred Sands: The Struggle for Community in the Indiana Dunes", stated "the best biography of Henry C. Cowles is [that by] Sarah Gibbard Cook."

Here, I convey the ecological communities' assessment of the contributions of Henry Chandler Cowles to the field of ecology and relate the findings of research from Cowles Bog since 1980 when this report was first completed.

Often at the Indiana Dunes, Henry Chandler Cowles is referred to as the "father of ecology". The term ecology was coined by Haeckel to refer to the "house" or "economy of nature" (Worster, 1985). Cowles' research was heavily influenced by the Danish scientist Eugenius Warming, who related plants to their climate via physiology and classified species occurring in the same environment as communities. Cowles showed that geological processes were modified by pioneer plants and that the plants influenced the direction of succession. Succession was not only determined by the physiological plant community characteristics of the dominant plants but by their interaction with bedrock geology, soil characteristics and moisture gradients across complex topographic landscapes: thus physiographic ecology was born. From observing the vegetation dynamics on the dunes Cowles developed the concept of succession as vegetation change in time (McIntosh, 1985).

The concept of succession however was not unique to Cowles. His contemporaneous colleague Frederick Clements conceived of succession as a central process in vegetation dynamics. Clements' view was more deterministic than Cowles' and he developed the analogy of succession to the life history of an organism, where succession proceeded mechanistically to a single climax stage. Cowles rejected this view and referred to succession as "a variable approaching a variable". It is unfortunate this biography of Cowles does not provide more information about their relationship since they jointly organized the International Phytogeographic Excursion to North America. Robert McIntosh pointed out Sarah Cook states at the end of Chapter III that Cowles said that succession "tended consistently toward a climax formation."

She is referring to Cowles' statement that the vegetation in the eastern climatic zone tended to succeed to mesophytic forest, but at differing rates on a variety of rock types. Her statement suggests some affinity with Clements' views; however, a reading of Cowles' paper shows he was careful to point out "it must not be rashly concluded, however, that there are not differences" and "that the various rock species are more alike than unlike during all stages of their history" (Cowles, 1901). Cowles did not believe that succession was 'organismically' deterministic, but recognized variability within the successional progression. In conclusion we view Cowles as the first significant contributor to the early American field of ecology in his development of physiographic ecology and dynamic successional concepts, but that he was not exclusively the father of the field of ecology.

Since 1980 considerable research has been conducted at Cowles Bog. Shedlock et al. (1993) demonstrated that Cowles Bog is a true fen by examining water chemistry and showing that the artesian water upwelling at Cowles Bog is from an older confined aquifer source, based on tritium concentrations. Cole et al. (1990) were able to use a peat core from Cowles Bog to document the atmospheric deposition of heavy metals in the region from prior to European settlement to the post Clean Air Act years. Heavy metal levels increased after settlement and during the industrialization period and showed a small but significant decline after the 1970s.

Futyma (1985) reconstructed the vegetation history of the Cowles Bog wetland complex from stratigraphic fossil pollen analysis. Prior to 6200 years before present (yrs BP) the area of Cowles Bog was probably terrestrial. About that time Lake Michigan was rising from the Chippawa low to the Nipissing high about 5000 yrs BP and this rise resulted in the formation of a shallow lake behind the shoreline dunes. From 6200 to 4500 yrs BP, marl was deposited in the lake and the only dominant pollen was pondweed (*Potamogeton*). After 4500 yrs BP, organic mud was deposited in the lake and water lilly (*Nymphaea*), spatterdock (*Nuphar*), water shield (*Brasenia*) and arrowleaf (*Sagitarria*) became prevalent. During this time a grass-dominated marsh was developing along the wetland edge. After 2000 yrs BP, the lake had completely filled-in with organic mud and marsh peat then a conifer swamp and graminoid fen developed. Tamarack and white pine with an understory of alder, holly, ferns and moss dominated the latter. This complex persisted until European settlement when pine, tamarack and sphagnum declined in the fen, the conifer swamp was converted to a hardwood swamp of birch (*Betula lutea*), red maple (*Acer rubrum*) and willow (*Salix* sp.) and cattail (*Typha* sp.) invaded the sedge meadow. Miller and Thompson (1987) found that mollusc fossils in a core from Cowles Bog corroborated the trends found in the pollen record, but also found alternations in the

abundance of aquatic and terrestrial fauna. This suggested short term oscillations in the water table that were driven perhaps by precipitation.

Wilcox et al. (1984) documented the invasion of cattail and the resulting decline of sedge meadow in the Cowles Bog wetland complex from 1938 to the early 80s. The invasion of cattail did not commence until the mid 1960s and has continued and resulted in the decline of the sedge meadow and graminoid fen. The floristically rich fen was what made Cowles Bog so famous among botanists. From disturbance history they concluded that the invasion of cattail best correlated with the construction of the diked ponds to the south and southwest of the wetland complex in 1971. These diked ponds elevated and stabilized water levels in the wetland complex. The authors were pessimistic about the cattail invasion ever being reversed.

Will Cowles Bog continue to be degraded by anthropogenic impacts or will it be restored in the 21st century? Since Cowles Bog was the core nucleus for the creation of a national park in the Indiana Dunes its importance transcends biological diversity and serves as a legacy to the developing conservation movement in North America. From this perspective, I hope that Cowles Bog will be restored.

Thank you to Dale B. Engquist, Superintendent at Indiana Dunes National Lakeshore for granting permission to publish the text. The Shirley Heinze Environmental Fund contributed funds to help defray the production costs. The manuscript was peer reviewed in 1998 by Jerry Olson, and Robert P. McIntosh. Ross Phillips and Victor Peoples scanned the original manuscript into computer format for editing prior to publication. The program for the Henry Chandler Cowles Memorial Symposium: 50 Years after his Retirement was added as Appendix IV. Minor editing was done and the figures added by Noel B. Pavlovic. Thank you to Judith Dartt of the Department of Special Collections, the University of Chicago Library for her gracious assistance in providing the photographs and for compiling the credits that accompany each photograph. Clara R. Simpson designed and produced this booklet under the direction of Christina M. Bentz, The Field Museum.

January 22, 1999
U.S. Geological Survey, Biological Resources Division
Lake Michigan Ecological Research Station
1100 N. Mineral Springs Rd.
Porter, IN 46304

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figure 1

Bog—*Larix Laricina* (American Larch) [sic] and *Quercus velutina* (Black Oak); *Quercus* seedlings in the foreground. Mineral Springs, Indiana, 19 Sept., 1916. Lantern slide, aep-ins121.
[*editor's note:* Cowles Bog, showing the absence of cattail. *Thuja occidentalis* (White Cedar) was mis-identified as American Larch.]

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All the photographs (figures 1,2, 7-13, cover) are courtesy of the Department of Special Collections, the University of Chicago Library. They are part of the University of Chicago Department of Botany Records and are being digitized by the University Library as American Environmental Photographs. Numbers correspond to the digitized collection.

Henry Chandler Cowles in
1911, cropped from figure 9

The research for this study has been done largely in the archives and collections of the University of Chicago libraries, the John Crerar Library, the Chicago Historical Society, the Chicago Public Library, the Indiana Dunes National Lakeshore, the editorial and geography libraries of Encyclopaedia Britannica, and the personal collection of Dr. Paul Voth [now deceased] of DeKalb, Illinois, Professor Emeritus of Botany at the University of Chicago. Dr. J. Ronald Engel, Associate Professor of Social Ethics at Meadville/Lombard Theological School in Chicago, whose research overlaps the subjects of this study, has contributed crucial ideas, information, and bibliographical discoveries.

Sarah Gibbard Cook, 1980

1

The Cowles Bog National Natural Landmark

On December 2, 1965, the United States Secretary of the Interior designated 56 acres of Porter County, Indiana, "Cowles Bog National Natural Landmark."[1] The property belonged to the Save the Dunes Council, which had bought it in the 1950s to save it from possible development or industrial destruction. The area included some wooded sand dunes, but most of it was wetland—part open cattail marsh, part swamp with various kinds of trees, and part, the part most often noted through the decades, a tamarack stand. When Congress, in 1966, authorized the creation of the Indiana Dunes National Lakeshore to preserve for public use certain "areas of scenic, scientific, and historic interest," Cowles Bog National Natural Landmark fell within the boundaries designated for the park. Now, in the 1980s, the Lakeshore management has a continuing responsibility to protect and preserve the Landmark together with the rest of the park. To this end, it is important for the management to understand the scientific and historic interest of each area to be preserved. The intention of this study is to clarify the place of Cowles Bog in the history of science by a study of the life of the botanist Henry Chandler Cowles, for whom it is named. What was his significance, and why is it appropriate to commemorate his name in a portion of the Indiana Dunes National Lakeshore? More specifically, how did his name come to be associated with the area now called "Cowles Bog"?

While Cowles himself is the central focus of this study, let us look first at the wetland which bears his name. The earliest printed reference to this specific wetland area dates from 1913, the year Professor Cowles took a group of visiting European botanists to see the "bog" and tamaracks as part of a tour of America. Cowles called the site "Mineral Springs" after the nearest road and railroad station, named for an artesian well further south along the road.[2] By 1917 the location was well known.

John O. Bowers wrote in April of that year about a fire which had invaded "the celebrated tamarack bog" the previous autumn,[3] and E. Stillman Bailey described "a wonderful tamarack swamp" which could be reached by a path leading west from Mineral Springs Road; Bailey found the swamp noteworthy for its flora but sadly damaged by flower-pickers who uprooted many plants.[4]

The earliest printed references to "Cowles Tamarack Swamp" and "Cowles Bog," by name, date from 1923. George Brennan linked Cowles' name principally with the tamaracks in "the Cowles Tamarack Swamp–named after the eminent botanist and leading authority on the plants of the Dunes, Doctor Henry W. [sic.] Cowles, of the University of Chicago, who has done so much to make it famous."[5] On the other hand, Cowles' student Herman Kurz (Ph.D. 1922) attached the professor's name not to the tamarack stand but rather to the adjacent unwooded wetland, "where tamarack and poison sumach grade into the old floating mat of Cowles' Bog."[6] Marcus Ward Lyon in 1927 repeated Brennan's usage: "The subdunal woods opposite Mineral Springs station form the very interesting Cowles' tamarack swamp."[7] At the same time, the name "Mineral Springs" continued to be attached to the tamarack stand, the floating mat adjoining it, or both.[8]

Just as Cowles' name has been used in connection with this wetland area since the 1920s, so has the term "bog" been associated for decades with the unwooded part of the area. We can understand what writers meant by "bog" in the context of their own descriptions of the wetland. Observations dating from 1913 to 1928 give us three important kinds of information about Cowles Bog as it then was. They tell us, first, about its vegetation; second, about its pH value and the presence or absence of acidity; and third, about the "quaking" quality of its surface.

The vegetation of Cowles Bog in the 1910s and 1920s was characterized by grasses and sedge, including bulrushes (figure 1). A British member of Cowles' 1913 tour group said the wetland showed all the stages of succession "through reed-swamp and sedge to tamarack wood."[9] Cowles' student and colleague George Fuller named swamp fern, spikerush, and water willow as the most characteristic plants of the sedge association found there in 1913 and 1925; his entire list of 99 plants in four Mineral Springs Bog associations is attached as an appendix to this study. Lyon described the bog as the only place in the region where arrow grass, hoary willow, pitcher plant, loosestife, grass of parnassus, and small fringed gentian could be found.[10] Kurz reported in 1928 that sphagnum was not characteristic of the wetland as a whole but

had developed locally at some places within it.[11] Cressey wrote about the site the same year, "For the most part it is covered with grasses. In one place, however, there is an isolated clump of tamaracks 25 feet high, below which the water is 10 feet deep.[12]

The pH reactions of the area were tested and reported by Kurz in two separate studies in the 1920s. Henry Cowles, more than twenty years earlier, had written that half-filled wetlands with little or no drainage might show some tendency toward acidity.[13] When Kurz tested this hypothesis on a number of wetlands, he discovered that they were of two distinct kinds: circumneutral and acid. "Cowles' Bog" he found to be in the circumneutral category, tending to be pH neutral rather than distinctively acid or alkaline. "Notwithstanding that the bog showed some local variations in reaction (10-*10*) [specific alkalinity (10) to acidity (*10*) meaning pH 8 to 6], it was evident that the floating mat was more nearly neutral than the older more or less acid hydromesophytic stage," he wrote in 1923.[14] Continuing the study five years later, he wrote, "Cowles bog, although alkaline in the open mat, becomes acid in the older forested portion despite the sparse and very local development of sphagnum."[15] His field tests showed that the acidity resulted from *Osmunda* (fern) remains. "Excepting the forest zone of Cowles bog with its ferns, these bogs must always have been circumneutral."[16]

To generations of students, the most fascinating feature of Cowles Bog was the way it shook when people walked on it. The surface layer of partially decomposed vegetable matter ("peat") had water underneath it. Kurz called it an "old floating mat";[17] Lyon called it a "quaking bog."[18] Cressey described it as a "quaking bog" that was "roughly 100 feet wide and over 200 yards long. No open pond is exposed, but over the bog there is a mattress of water-soaked vegetation from 4 to 10 inches thick . . . . On walking over this bog, the vegetation quakes within a ten-foot radius."[19]

In applying the word "bog" to this sedge- and grass-covered, alkaline or circumneutral, floating mat, most writers simply followed convention; but a few discussed their choice of term. Cowles himself used "peat bog" as a synonym for "undrained swamp," meaning an intermediate stage in the succession from open pond to prairie; lack of drainage was the common element shared by the several kinds of plant communities which counted as "bog."[20] In addressing Europeans, Cowles temporarily adopted the English term "fen"; thus his excursion notes of 1913 described the "Mineral Springs bog" as part of a valley "now characterized chiefly by a fen vegeta-

tion."[21] An Englishman on the excursion described the wetland as a "swamp" with "a floating layer of peat" that had "many of the characteristics of English fen." His fellow Europeans tried to apply their European terminology to the succession of this American wetland and concluded that it was "essentially of the 'Niedermoor' or fen type, with local tendencies only to develop a 'Hochmoor' vegetation."[22]

Herman Kurz, in his studies of bog reactions in the 1920s, discussed his own choice of language:

> The term "bog," when unmodified, for the sake of American custom, is applied in a general sense to both types of habitats herein studied [acid and circumneutral].... Many of our so-called "swamps," "tamarack swamps," "tamarack bogs," "cedar bogs," "cedar swamps," "mixed bogs" and so on, fall under the general category of circumneutral bogs.[23]

Both the "Cowles" and the "Bog" of Cowles Bog, then, were in common use as early as the 1920s for the same wetland that bears that name today. What has been the life history of Cowles Bog since the writers quoted above described it in the 1910s and 1920s? Already at that time, it may have shown some effects of human interference. People used the trail or road that passes between the dunes and the wetland from an early date; Brennan in 1923 identified it as the remains of "a fine corduroy road" which had been in use half a century earlier.[24] In addition, agricultural drainage ditches in the area are said to have been present as early as the 1880s and were enlarged between 1903 and 1910 as State Ditch and Samuelson Ditch.[25] In 1923-24, the development of the Town of Dune Acres and its golf course brought further development of both the road and the drainage ditching. Drainage, fires, flower-picking, and the cutting of trees were the four influences observers in the 1910s and 1920s regarded as posing the greatest danger to the area.[26]

By the 1950s, industrial development had been added to the list of conspicuous threats to the integrity of the duneland and wetland areas. Nonresident landowners such as Edgar D. Crumpacker (Valparaiso lawyer and congressman) and descendents held unimproved land as a real estate investment for future development. In an attempt to counter the threat, concerned citizens formed the Save the Dunes Council. One of its first acts was to purchase, at a tax sale, 56 acres of former Crumpacker land west of Mineral Springs Road.[27]

The boundaries of the Save the Dunes Council purchase became, in the 1960s,

the boundaries of the national landmark. In 1964, the Secretary of the Interior instituted a program of registered natural landmarks modeled on the older (1957 ff.) historic landmark program, to illustrate important segments of America's natural heritage and encourage their preservation. Seven applications for natural landmark designation were approved in 1964 and a larger number in 1965. The Save the Dunes Council nominated their 56 acres for designation, applying the name "Cowles Bog" to the entire area. The privately owned Pinhook Bog, to the southeast, was also nominated.

Maurice Sullivan, who had begun his studies in botany at the University of Chicago (Ph.D. 1938) before Cowles retired, conducted preliminary studies of both wetlands. Sullivan made field trips to Cowles Bog and Pinhook Bog and submitted reports recommending both wetlands for inclusion in the national register.[28] The Advisory Board on National Parks, Historic Sites, Buildings, and Monuments, meeting in Washington and Harpers Ferry on October 4-7, 1965, studied the Cowles Bog report and recommended designation. The Secretary of the Interior designated Cowles Bog a natural landmark on December 2. Pinhook Bog was also approved for the register. These were the first "bogs" to be set aside as natural landmarks. They were dedicated at a ceremony in Gary on February 26, 1966, and the Save the Dunes Council received a certificate and plaque in recognition of their property's landmark status.[29]

With the landmark designation, the name "Cowles Bog" not only became official, it also became attached to a specific rectangle of land, including sand dunes and the tamarack stand as well as areas of grass and sedge. Its boundaries are no longer defined by its vegetation, but rather by former property lines based on a rectangular survey. While it bears a name that has been in use for the same general area since the 1920s, the land to which the name applies has been redefined. The "Cowles Bog" of the national landmark is only an approximation of the "Cowles Bog" and "Cowles Tamarack Swamp" described by the writers of the 1920s.

Cowles' name is now formally preserved in connection with this segment of the Indiana Dunes National Lakeshore. We have traced the history of the wetland and of the use of Cowles' name in connection with it; but we have yet to answer the questions with which we began this chapter. Who was Henry Chandler Cowles? Why is he worth remembering, if at all? What role did the Indiana Dunes play in his life and

work, and what impact did he have on them in turn? Having looked at the National Natural Landmark that bears his name, let us now turn to the man himself.

Notes to Chapter 1

1 "Registry of National Historic Landmarks: Summary Data for Cowles Bog," Transcript (TS) copy in the possession of the Indiana Dunes National Lakeshore; some associated documents and correspondence indicate the area as 57 acres, but 56 acres is the figure used as the basis for the Lakeshore purchase of the property from the Save the Dunes Council.

2 Henry C. Cowles, *The International Phytogeographic Excursion (I.P.E.) in America. 1913. Excursion Program. First Section—New York to London* (Chicago, 24 July 1913), 11.

3 John O. Bowers, "Salvation of Dunes Depends on Action To Prevent More Havoc," *Gary Evening Post*, Dunes Edition, 16 April 1917, p. 4.

4 E. Stillman Bailey, *The Sand Dunes of Indiana* (Chicago: A. C. McClurg & Co., 1917), 156.

5 George A. Brennan, *The Wonders of the Dunes* (Indianapolis: Bobbs-Merrill, 1923), 145.

6 Herman Kurz, "Hydrogen Ion Concentration in Relation to Ecological Factors," *Botanical Gazette*, 76, No. 1 (Sept. 1923), 17.

7 Marcus Ward Lyon, Jr., "List of Flowering Plants and Ferns in the Dunes State Park and Vicinity, Porter County, Indiana," *American Midland Naturalist*, 10 (1927), 249.

8 George Babcock Cressey, *The Indiana Sand Dunes and Shore Lines of the Lake Michigan Basin* (Chicago: University of Chicago Press, for the Geographic Society of Chicago, 1928), 68; H. S. Pepoon, An Annotated Flora of the Chicago Area (Chicago, 1927), 109; Lyon, "List of Flowering Plants," 249.

9 A. G. Tansley, "International Phytogeographic Excursion (I.P.E.) in America, 1913," *New Phytologist*, 12, Nos. 9, 10 (Nov., Dec. 1913).

10 Lyon, "List of Flowering Plants," 249.

11 Herman Kurz, "Influence of Sphagnum and Other Mosses on Bog Reactions," *Ecology*, 9 (1928), 60.

12 Cressey, *Indiana Sand Dunes*, 68.

13 Henry C. Cowles, "The Physiographic Ecology of Chicago and Vicinity; a Study of the Origin, Development, and Classification of Plant Societies," *Botanical Gazette*, 31, Nos. 2, 3 (March, April 1901), 73-108, 145-82.

14 Kurz, "Hydrogen Ion Concentration," 20.

15 Kurz, "Influence of Sphagnum," 60.

16 Kurz, "Influence of Sphagnum," 61.

17 Kurz, "Hydrogen Ion Concentration," 17.

18 Lyon, "List of Flowering Plants," 249.

19 Cressey, *Indiana Sand Dunes*, 68.

20 Cowles, "Physiographic Ecology of Chicago and Vicinity."

21 Cowles, *International Phytogeographic Excursion Program*, 11.

22 Tansley, "International Phytogeographic Excursion," 330-31.

23 Kurz, "Influence of Sphagnum," 64, 67-68.

24 Brennan, *Wonders of the Dunes*, 77.

25 For a discussion of drainage ditching in the area, see Sarah Gibbard Cook and Robert S Jackson, *The Bailly Area of Porter County, Indiana* (Evanston, Ill.: Robert Jackson & Associates, 1978), 58-65.

26 Brennan, *Wonders of the Dunes*, 145; Bailey, *Sand Dunes of Indiana*, 156; Bowers, "Salvation of Dunes," 4.

27 For a record of previous ownership of the property, based on county plat books, see Cook and Jackson, *Bailly Area*, Figure 8.

28 Maurice Sullivan, "A Report on Cowles Bog, Indiana" and "A Report on Pinhook Bog, Indiana," TS copies in the possession of the Indiana Dunes National Lakeshore.

29 Stanley A. Cain, "Remarks at the Dedication of Cowles and Pinhook Bogs," Dept. of the Interior News Release, 27 Feb. 1966; correspondence and memoranda in the possession of the Indiana Dunes National Lakeshore.

figure 2

Rhus vernix (Poison sumac); Mineral Springs, Indiana,
10 August 1910. Glass negative, aep-inn107
[*editor's note:* Cattails (foreground) were present in Cowles Bog but not dominant then.]

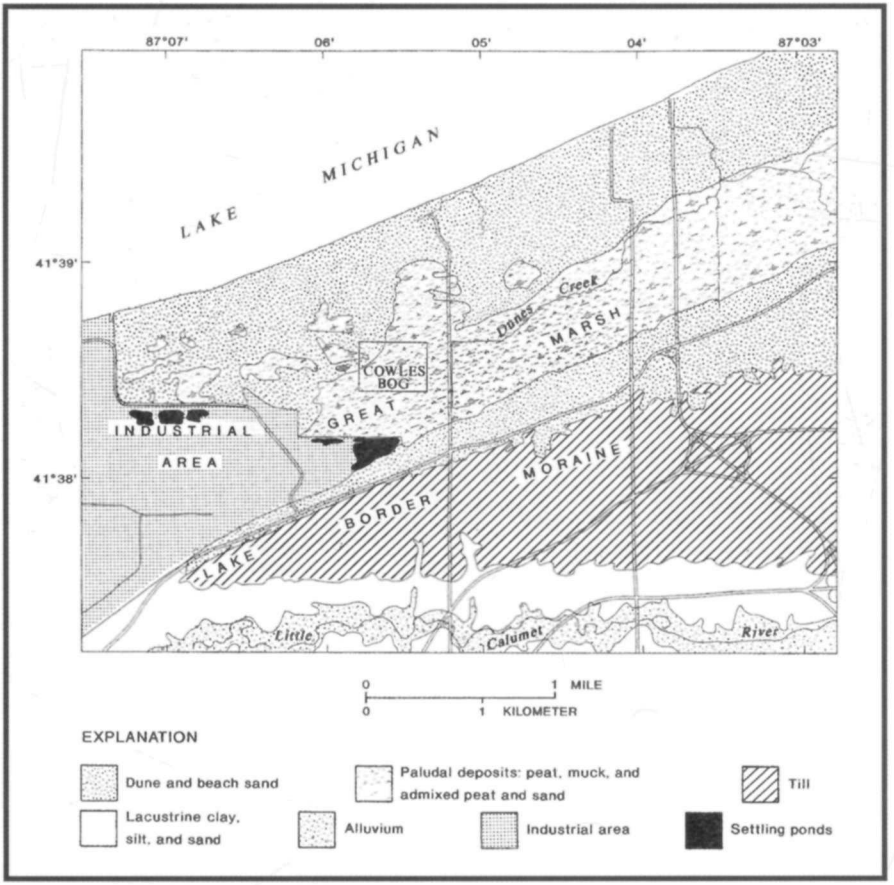

figure 3

Map of surficial geology and drainage at and surrounding Cowles Bog.
from Shedlock et al. 1993 *Journal of Hydrology* 141:130; printed with the permission of Elsevier Scientific Publishing.

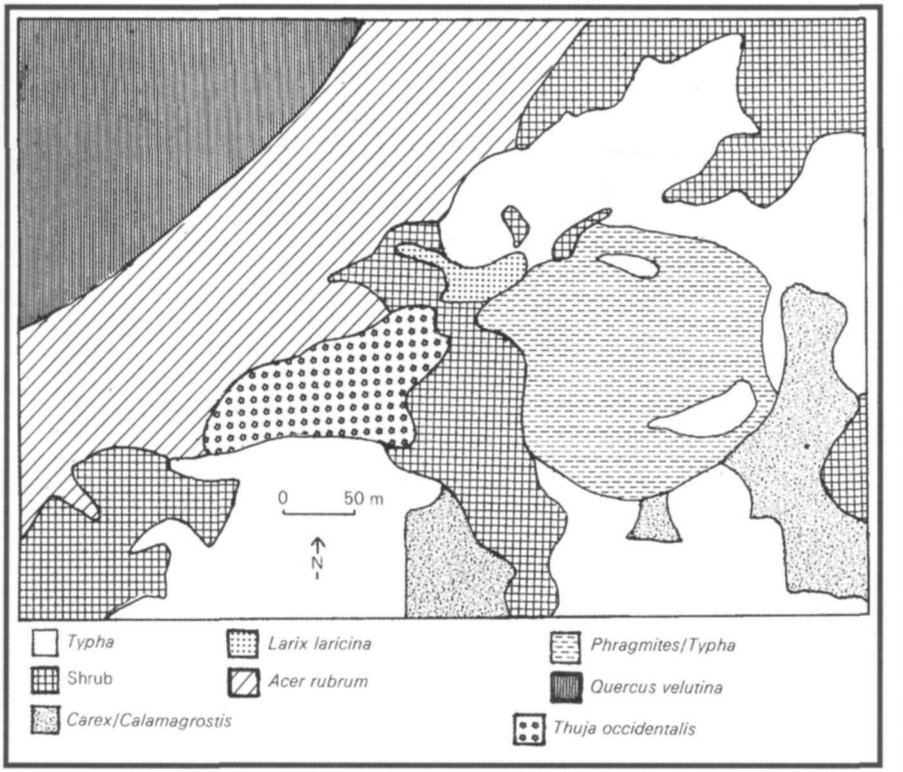

figure 4

Map of vegetation types in Cowles Bog National Natural Landmark. Ellipsoidal cattail (*Typha*) area to the northwest of the tamarack (*Larix laricina*) patch is the former sedge fen community. *from* Wilcox et al. 1986 *Journal of Ecology* 74:1107; printed with the permission of Blackwell Scientific Publishing.

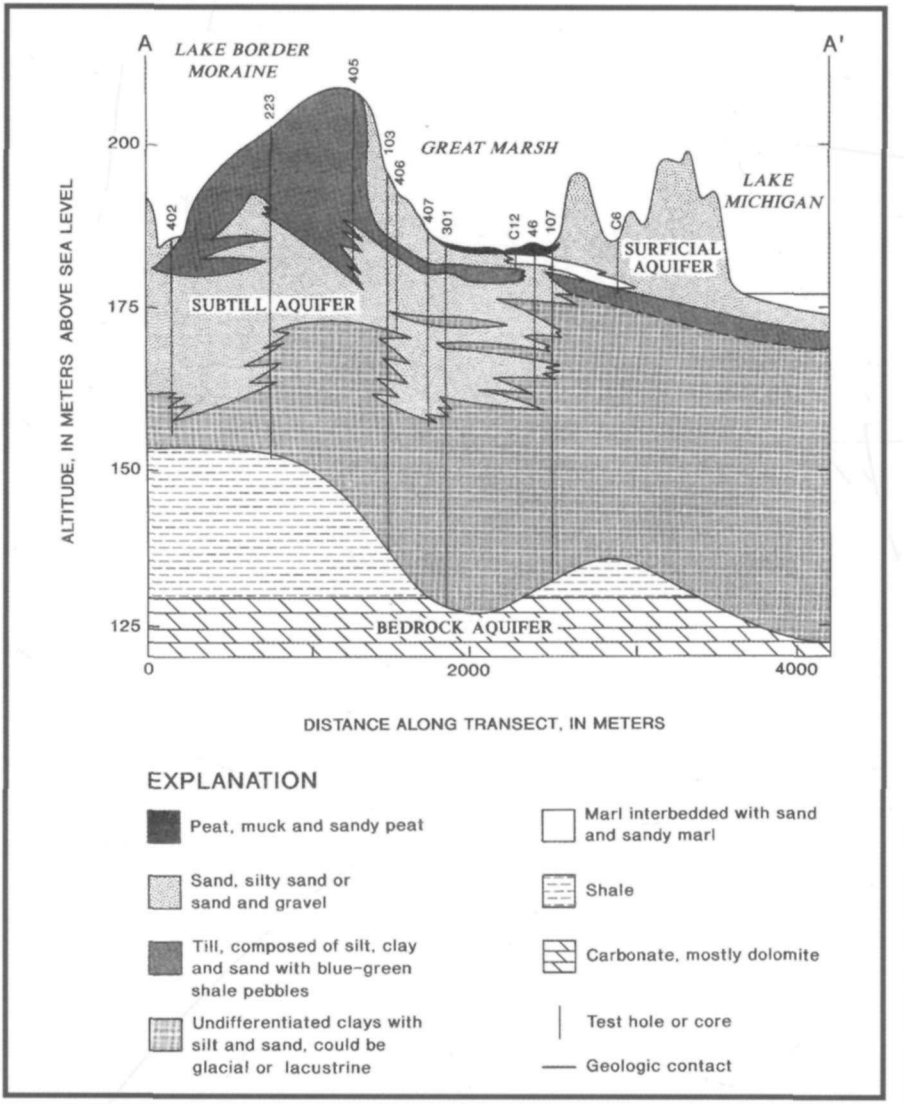

figure 5

South to north geological section through Cowles Bog (labeled 46). *from* Shedlock et al. 1993 *Journal of Hydrology* 141:134; printed with the permission of Elsevier Scientific Publishing.

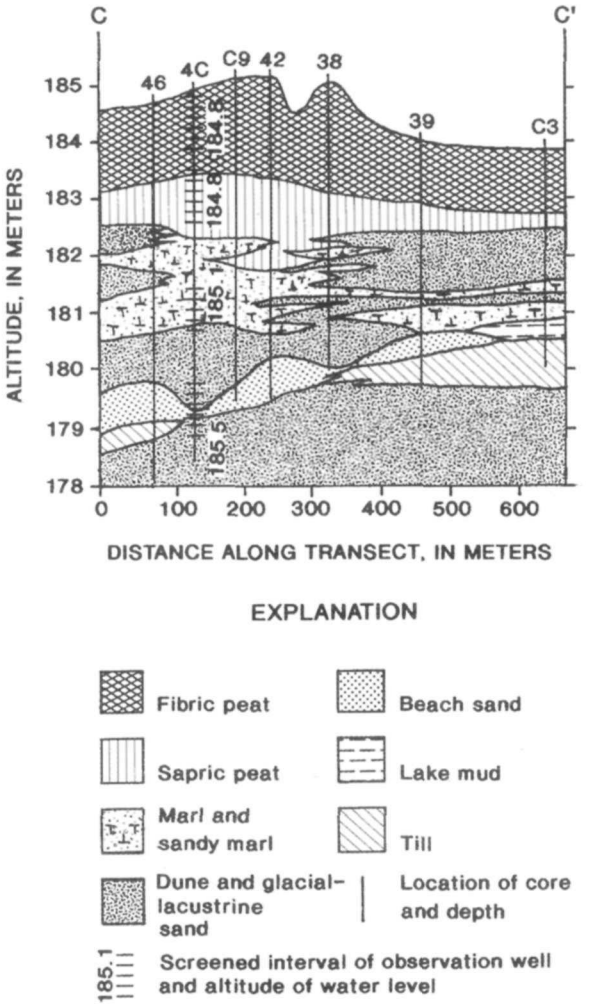

figure 6

West to east hydrological section through Cowles Bog showing the raised peat mound.
from Shedlock et al. 1993 *Journal of Hydrology* 141:148; printed with the permission of Elsevier Scientific Publishing.

2

The Hull Botanical Laboratory

Henry Chandler Cowles spent his entire career, from the time he first began graduate study in botany until his retirement nearly forty years later, in the Botany Department of the University of Chicago. He initially became involved with the department as it was first coming into existence; by the time he retired, the University had produced more than 200 botany Ph.D.'s (listed in Appendix II). It seems appropriate, then, that the story of Cowles' career should start with the story of the Botany Department itself.

In 1894 the new University of Chicago asked John Merle Coulter—author of *A Manual of the Botany of the Rocky Mountain Region* (1885) and founder/editor of the *Botanical Gazette* (1875 ff.)—to take charge of graduate work in botany.[1] Coulter, born in China in 1851 and raised in southern Indiana, had first studied and taught the classics but had discovered an avocation for the study of plants. After serving as botanist for the Hayden geological survey of Yellowstone and the western territories (1872-74), he had returned to Hanover College, Indiana, to teach science. There, on his own initiative and at his own expense, he had begun to produce a newsletter (The *Botanical Gazette*) to help plant scientists keep in touch. "In those days," Coulter recalled years later, "botany, although an old subject, was still in its very early stages. It consisted merely in collecting plants and discovering their names."[2] Like most other botanists of that period, including his mentor Asa Gray, Coulter concentrated his attention on taxonomy: the classification of plants into genus and species, "discovering their names." Nevertheless, he recognized the significance of the new developments in botany which began to emerge toward the end of the century, in part as a response to the implications of Lyell's geology and Darwin's theory of evolution; and students of the fledgling fields of paleobotany, morphology, plant pathology, and

plant physiology—scholars studying plants as living, functioning, changing organisms—found a forum in Coulter's *Botanical Gazette*. As Coulter's prestige grew, he moved from Hanover to Wabash College, Indiana (1879-91), then to Indiana University (president, 1891-93), and then to Lake Forest College, Illinois, where he was serving as president (1893-96) when the University of Chicago invited him to develop a graduate department in botany.[3]

Coulter accepted the title "professorial lecturer" with the understanding that his appointment was the first step toward the creation of a fully functioning Botany Department.[4] Retaining his position at Lake Forest, for two years he commuted to the south side of Chicago on Saturdays to offer instruction in botany to interested students, delivering his lectures in the third floor library/laboratory/lecture hall of Walker Museum for lack of any better facility. Two graduate students in particular, that were enrolled in other departments of the University, attracted Coulter's attention. One was Charles Joseph Chamberlain, in animal physiology at the University since 1893. The other was Henry Chandler Cowles, in geology there since 1895.[5]

Both Chamberlain and Cowles had done their undergraduate study at Oberlin College, Ohio, and had there been drawn to botany under the inspiring influence of Professor A. A. Wright. The elder, Chamberlain, born into an Ohio farm family in 1863, had moved to Oberlin with his parents in 1881 and completed his B.A. at the college seven years later. Although he then left to teach, he returned to Oberlin in the summers to continue studying the structure of plant and animal tissues under Professor Wright, and in 1894 Oberlin awarded him an M.A. on the strength of his summer studies.[6]

Meanwhile Cowles—born in Kensington, Connecticut, just south of New Britain, on February 27, 1869, and educated in the Kensington public schools and New Britain High School—matriculated at Oberlin and began his own studies under Wright. Wright, a skillful teacher out in the field as well as in the classroom, encouraged Cowles' interest in geology and also introduced him to taxonomic botany and the local distribution of plants. Cowles undoubtedly made Chamberlain's acquaintance during the latter's summers back at the college. Cowles also edited the *Oberlin Review* and studied the humanities, especially Latin and Greek. When he graduated with a B.A. in 1893 he delivered the Greek oration for his class.[7]

After one year of teaching natural science at Gates College, Nebraska (1894-95),

Cowles received a fellowship to the new University of Chicago to study geology. He began his work there in 1895, studying landforms and plant fossils of the ice age under the guidance of professors Rollin D. Salisbury and Thomas C. Chamberlin, both of whom were notable scholars of the dynamics of change in the shape of the landscape. They introduced him to the moraines and beach ridges of the Chicago area, left behind by the retreat of the great glaciers and their successor lakes, precursors of Lake Michigan. Cowles also attended Coulter's botany lectures; Charles Chamberlain was a fellow student in the class.[8]

One of the topics Coulter chose to share with his class was the epochal new work by the Danish botanist Eugenius Warming, *Plantesamfund* ("plant community"), published in Danish in 1895. Warming's study of plants in relation to their environment was a major departure from the conventional botany of collecting and naming plants. Botanists who had given any attention to the geographical distribution of plant communities had, for the most part, been satisfied with observation and description. Working within the framework set forth by Oscar Drude of Dresden in his classic *Handbook of Plant Geography* (1890), they listed which plants grew where, what plants were found together, and how the locations of particular plants related to the overall geographical range for those plants. The more sophisticated students of plant geography might do quantitative studies, counting the frequency with which each plant occurred in a given area, or might draw inferences about plant migration patterns by comparing the locations in which a given species was found.

Warming introduced a new kind of analysis to the study of plant communities and their locations. He asked: 1) what physical properties of a locale encouraged or prevented the growth of a particular plant species, and 2) what physical properties of a plant favored or hindered its growth in a particular locale? Specifically, he studied the plant communities of Denmark and classified them according to the water content of the soil. Plants especially well suited for dry habitats he called xerophytes; those thriving in abundant water, hydrophytes; and those which characteristically grew in soils of moderate moisture, mesophytes. The appropriateness or adaptability of a plant's organs to a particular environment largely determined where that plant grew. Warming illustrated his findings with a discussion of the vegetation of the extremely xerophytic sand dunes of the Danish seacoast and that of the Danish hydrophytic swamps. He defined plant ecology as a field for analytical study, provided a vocabulary for discussing it, and offered a system for classifying plant communities in relation to soil water.

Coulter recognized the great significance of this new work and made it the basis of some of his lectures. Charles Chamberlain recalled the class years afterward:

> None of us could read Danish except a Danish student, who would translate a couple of chapters, and the next day Coulter would give a wonderful lecture on Ecology. . . . While we heard the translation, none of us knew what it was all about until Coulter lectured. Cowles, with his superior knowledge of taxonomy and his geology, understood more than the rest of us, and became so interested that he studied Danish and, long before any translation appeared, could read the book in the original.[9]

Coulter fostered Cowles' interest in Warming and encouraged him to combine his study of dynamic physiography with plant ecology. Warming had written about the vegetation of the sand dunes on the coast of Denmark. Coulter encouraged Cowles to explore the plant communities of the nearby Lake Michigan dunes and see whether his findings corresponded to those of Warming. Cowles first saw the Lake Michigan dunes and their flora in 1896, at Dune Park, Indiana, where the Michigan Southern Railroad had a station. It was the beginning of a lifelong study of dunelands all over the world.[10]

Meanwhile, a million dollar endowment for botany ("the Culver gift") contributed to the University in the winter of 1895-96 opened the prospect of a fully staffed Botany Department with a building of its own. Coulter left Lake Forest and came to Chicago full time as head professor of the incipient department. He brought with him the *Botanical Gazette*; while he and friends continued to edit the journal, they happily let the University of Chicago assume ownership and financial responsibility, beginning with the March 1896 issue. On July 3, 1896, Coulter officiated at the laying of the cornerstone for the new Hull Botanical Laboratory. Construction of the elaborate four-story structure (with lecture rooms, libraries, laboratories, rooms for private research, and a roof greenhouse) was completed in the spring of 1897, and Coulter set about organizing his department to begin offering a full graduate program in botany that fall.[11] He asked Chamberlain and Cowles to serve as his assistants.

Coulter treated Cowles as the departmental expert in plant ecology. In the fall of 1897, Cowles delivered a six-lecture series on the subject, discussing in turn the effects on vegetation of light, heat, air, water (two lectures), and soil. The "references" listed with each lecture outline included pages out of Warming's book, still the major

work in the field.[12] Coulter also had Cowles write brief reviews of botanical books and articles for the *Botanical Gazette*, varying in length from a sentence to several pages. Beginning with the December issue, 1896, Cowles wrote short items in practically every volume of the journal for the rest of his career.

While he taught and wrote for the *Botanical Gazette*, Cowles also pursued his study of the Lake Michigan dunes and the relation of their vegetation to their changing shapes. Dune Park, where he had first met the duneland, was the focus of his study; he went back time and again, in all seasons, to trace its changes. In November, 1897, he drove a stake into the ground at the base of an advancing dune there to measure its movement; when he checked it in May it was almost covered, and by July it had completely disappeared.[13] His duneland studies took him further from home as well. In the summer of 1897, he traveled in the state of Michigan up and down the eastern shore of the lake, visiting the great Sleeping Bear Dune of Glen Haven (northwest of Traverse City) and other sand hills along the shore.[14] The next summer, after completing his first year of teaching at Chicago and passing his Ph.D. examination, he conducted a six week field class with 12 students (see p.44). They visited North Manitou Island, Michigan, in Lake Michigan, and spent some time on Beaver Island and probably on Mackinac as well.[15] He drew on material from all these areas for his dissertation and its modified, published version.

"An Ecological Study of the Sand Dune Flora of Northern Indiana" was the title of Cowles' dissertation. His Ph.D. (1898, in both geology and botany) was one of the first five botany Ph.D.'s granted by the University of Chicago; Chamberlain had earned his the year before (Appendix II). In 1899, in the February through May issues of the *Botanical Gazette*, Cowles published his thesis in modified form under the title, "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan."[16] It was his first major publication.

It is not entirely fair to treat the completion of Cowles' doctorate as a sharp dividing line between his years as a student and those as a teacher and scholar. On the one hand, he continued to study sand dunes and other topographies, with their plant communities, for the rest of his life. On the other hand, he had already been teaching and writing journal reviews for a year or two before his dissertation was completed. Nevertheless, the publication of his thesis did mark a real turning point. Until then he had been the Hull Botanical Laboratory's star student and ecological expert. With the appearance in 1899 of his article in the *Botanical Gazette*, followed by two

other substantial articles in 1901, he took his place as an influential scholar in the international community of botanists. Having seen him through his preparatory period, let us now look in more detail at the three papers which together made his basic statement and established his reputation.

Notes to Chapter 2

1 *Botanical Gazette*, 19, No. 4 (Oct. 1894), 424.

2 John Merle Coulter, "Address of Professor Coulter: Charles Reid Barnes," *Local Church News* [1910], document in the possession of Dr. Paul Voth, 6.

3 *A Record of The Doctors in Botany of the University of Chicago 1897-1916 Presented to John Merle Coulter* (Chicago, rpt. from the single presentation copy, 1916), iv; Andrew Denny Rodgers, III, *John Merle Coulter, Missionary in Science* (Princeton, N.J.: Princeton University Press, 1944), *passim*; *Botanical Gazette*, *passim*; Cowles, "John Merles Coulter," *Botanical Gazette*, 87, No. 2 (March 1929), 211-17.

4 *Botanical Gazette*, 19, No. 4 (Oct. 1894), 424.

5 Paul D. Voth, untitled TS biography of Charles Chamberlain in Dr. Voth's possession, endorsed "submitted to Dictionary of American Biography 1969"; Charles J. Chamberlain, "Henry Chandler Cowles," speech apparently presented at ceremony recognizing Cowles' retirement, TS copy in Dr. Voth's possession.

6 Voth, TS biography of Chamberlain, 1, 2.

7 Chamberlain, "Henry Chandler Cowles," 1-3; Charles C. Adams and George D. Fuller, "Henry Chandler Cowles, Physiographic Plant Ecologist," *Annals of the Association of American Geographers*, 30 (1940), 39, 42; Ezra Jacob Kraus, "Henry Chandler Cowles," *Botanical Gazette*, 101, No. 2 (Dec. 1939), 241; Cowles, "The Economic Trend of Botany," *Science*, NS 41, No. 1050 (12 Feb. 1915), 225.

8 William S. Cooper, "Henry Chandler Cowles," *Ecology*, 16, No. 3 (July 1935), 281; Adams and Fuller, "Henry Chandler Cowles," 39.

9 Chamberlain, "Henry Chandler Cowles," 9.

10 Cowles, "A Fifteen-Year Study of Advancing Sand Dunes," *Report of the Eighty-First Meeting of the British Association for the Advancement of Science* (London: John Murray, 1912), 565; Adams and Fuller, "Henry Chandler Cowles," 39; Cooper, "Henry Chandler Cowles," 281.

11 *Botanical Gazette*, 21, No. 3 (March 1896), 171, 183; *Botanical Gazette*, 22, No. 1 (July 1896), 78.

12 Cowles, "Lectures on Ecology" (The College Endowment Association, Science Section, 1897).

13 Cowles, "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan," *Botanical Gazette*, 27, No. 2 (Feb. 1899), 97, 100, and No. 4 (April 1899), 281; Cowles, "Fifteen-Year Study," 565.

14 Cowles, "Fifteen-Year Study," 565; Cowles, "Ecological Relations," 194.

15 Cowles, "Ecological Relations," 97, 103, 106, 186.

16 *Botanical Gazette*, 27, Nos. 2, 3, 4, 5 (Feb., March, April, May 1899, 95-117, 167-202, 281-302, 361-91.

figure 7

Advance of dunes, Dune Park, (Wilson) Indiana. Glass negative by Ira Benton Meyers; aep-inn63. cropped.
[*editor's note:* Where Cowles first saw the dunes and observed active dunes overtaking vegetation.]

3

Physiographic Ecology and Ecological Succession (1899-1901)

In 1899-1901, Cowles published three papers that formed the basis of his international reputation as an ecologist. The first drew its arguments and examples specifically from the Lake Michigan sand dunes; the second, from a greater variety of sites near Chicago; and the third, from places all over the United States. The three papers collectively developed two concepts that lay at the heart of Cowles' contribution to ecological theory: the paramount influence of the shape of the land—topography—on the composition of plant communities; and the patterns of change over time by which one plant community succeeds another, leading gradually to a climax formation.

"The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan"[1] was the published version of Cowles' doctoral dissertation. Focused exclusively on the dunes, it was a study in physiography as much as ecology, for the life cycle of a sand dune involved wind, water, and sand as well as grasses, cottonwoods, and pines. Both disciplines, Cowles wrote, studied landscapes in the making; ecology was "to structural botany what dynamic geology" was "to structural geology".[2] As a student of both geology and botany, Cowles showed a continuing concern for bringing the two disciplines closer together. In preparing reviews for the *Botanical Gazette*, he rejoiced when he found a book written for botanists and geologists together,[3] and he expressed regret that Schimper (*Plant Geography on a Physiological Basis*) did not pay more attention to "the geological relation."[4] The connection between physiography and plant ecology was a central point of Cowles' "Ecological Relations."

However, Cowles did not simply observe the present structure of a sand dune

and relate it to the present vegetation. He also considered the dimension of time. In the Schimper review he wrote, "In order to understand any formation it is necessary to know its history . . . The study of the cumulative influence of past environments, the lagging of effects behind their causes, is still in its infancy."[5] Vegetational succession was not Cowles' personal discovery but rather an infant field of study to which he was an important contributor. For instance, one of his first published reviews had been of Nilsson's study of coniferous forests in Sweden, which concluded with a survey of "factors influencing the succession of plant societies," including the process by which each species affects the soil in a way disadvantageous to itself and thus paves the way for different species to replace it.[6] Cowles' "Ecological Relations" was a significant contribution to a small but growing body of literature on specific examples of ecological succession.

Cowles did his research on dunes in a number of locations, but the principal one was Dune Park, Indiana, where he first made the acquaintance of the Lake Michigan dunes in the year 1896.[7] Even after visiting many other parts of the lakeshore, he kept coming back to Dune Park as the most extensive area of dune activity near the southern end of the lake, and as the best example of specific phenomena such as dunes advancing on a swamp.[8] Its moving dunes, among the least stable landforms on earth, made Dune Park an ideal place for studying process, or what Cowles called the "dynamic viewpoint." Because they changed so rapidly, dunes in many different stages could be found within a relatively small area, and the movement of a particular dune could be observed and measured; when Cowles placed a stake in the path of an advancing dune, he returned to find the stake completely covered only eight months later.[9] It is possible that the dunes at the southern end of Lake Michigan were in especially rapid transition in the late 1890s because of a dramatic change which had just taken place in the water level of Lake Michigan: between June 1886 and June 1896 it had dropped almost four feet, possibly in part because of the construction (begun in 1892) of the Chicago Sanitary and Ship Canal giving the Lake an outlet toward the Mississippi.[10] Whether or not the changing lake levels played a role, the dunescape itself was constantly changing. It was also still largely untouched by human activity, although some sand had been removed for use in railroad gradings, and the pines near Whiting showed damage from the fumes of Whiting's oil refineries.[11]

Cowles found that the plant life of the Lake Michigan dunes resembled that of Warming's coastal dunes in Denmark. The similarity of topography outweighed the

difference between freshwater and saltwater dunes, or between American and European floras. Cowles traced the development of a dune from a young, bare, moving hill of windblown sand, through stages of increasing stability brought about by the growth first of marram grass, then of cottonwoods, juniper, and pine, then of oak, and finally of the mesophytic beech-maple deciduous forest which was the climax formation (the stable, self-perpetuating plant community toward which all previous succession tended) for most of the eastern United States. In each case the vegetation affected the conditions of soil stability, slope, humus composition, and shade in a way that made the dry dune environment more mesophytic and made possible the growth of the plants of the next successional stage.

Cowles' article was read and made an impression as far away as Europe. A British botanist wrote fourteen years later, "One of the greatest attractions of the Chicago neighborhood to the ecologist is, of course, the magnificent series of sand-dunes on the southern and eastern shores of Lake Michigan, and . . . the vegetation of these dunes [is] well-known to students of ecology from Professor Cowles' paper in the *Botanical Gazette* for 1899."[12] Closer to home, there were those who had less appreciation for the value of scientific study when they could not immediately see its practical applications. As Cowles told the story, he showed his article with youthful pride to a man who deflated him by responding, "Well, what of it?"[13] The tension between theoretical and applied ecology would become a matter of some concern to Cowles in later years; but in 1899, his major interest was to convey his findings within the world of theoretical botanists.

In February and March, 1901, Cowles published a second article in the *Botanical Gazette*: "The Physiographic Ecology of Chicago and Vicinity; A Study of the Origin, Development, and Classification of Plant Societies."[14] Far more sweeping in its goals than his earlier study of the dunes, this paper attempted nothing less than to provide ecologists with an overall system of classification for plant communities. Ecology had been drawing increasing attention among botanists in recent years, Cowles observed; now it was time to bring some order to the chaos.

First, he divided the entire field of ecology into four broad areas of study. Two involved the origin and development of individual plant structures in relation to their environment: organographic ecology, or the study of plants or organs as a whole, and ecological anatomy, or the study of the tissues that made up the organs. The other two broad areas, geographic ecology and physiographic ecology, involved the origin

and development of plant societies or "formations." Geographic ecology (also called ecological plant geography) was the study of the broad regional distribution of plants according to climate, including temperature and atmosphere; geographic ecologists explored the differences between tropical evergreen forests, great deserts in continental interiors, prairies, deciduous forests, and arctic tundras. This area of study was the main focus of Schimper's classic *Plant Geography on a Physiological Basis* (1898), which Cowles consulted regularly in his own work.[15] Finally, physiographic ecology was the study of the local distribution of plants, according to such local factors as soil, slope, and light, within a single climatic zone.

Physiographic ecology was Cowles' central interest. Warming, who had introduced the term "plant community," had provided an initial basis for classifying local plant societies according to the water content of the soil. In 1896 and 1897 Cowles, with his students, had attempted to classify the flora of greater Chicago according to Warming's categories, and in 1898 they had carried the experiment into northern Michigan.[16] They found, however, that the water content of the soil, while vitally important, was an insufficient guide to differences in plant communities. Two locations could have quite different flora growing in identical amounts of moisture. Something had to be added to Warming's classification system to account for these differences. The missing element, Cowles concluded, was topographic succession. He called this approach "the physiographic theory."

Cowles classified the landforms of greater Chicago and described the typical succession patterns of each. Types included the river series (ravine, river bluff, flood plain), the pond-swamp-prairie series, the upland series (rock hill, clay hill, sand hill), the lake bluff series, and the beach-dune-sand hill series. Within the pond-swamp-prairie series, it is worth noting that Cowles used the term "peat bog" synonymously with "undrained swamp," to include several different kinds of plant communities which had in common a lack of drainage, with a resultant dependence on rainfall and evaporation for change of water, little oxidation, and a tendency to acidity.

In the case of each kind of landform, Cowles found that erosion tended, in the long run, to have a leveling influence by wearing away hills and filling up valleys. "Modern physiography has made a logical classification of dynamic surface forces, and has found a progressive tendency toward a definite end," he wrote. "Denudation of the uplands and deposition in the lowlands results in an ultimate planation, known as the base level."[17] The concept of the base level, borrowed from geology,

was a popular subject of discussion among zoologists and botanists around the turn of the century. As early as 1894, J. B. Woodworth had written about "The Relation Between Base-Leveling and Organic Evolution" with reference to animals. At the time that Cowles was writing, Charles C. Adams was doing further work on base-leveling and animals, while Chicago student Harry N. Whitford was preparing a physiographic study of the forests of northern Michigan.[18] Adams, Whitford, and Cowles together conducted a symposium, "The Relation of Base-Leveling to Specific Differentiation," at the end of December, 1900. This may have been Cowles' first formal presentation at a scholarly meeting—the second annual meeting of the Central States Naturalists—conveniently held in Chicago.[19] The theme of leveling in relation to species, then, was very much in Cowles' mind as he wrote "The Physiographic Ecology of Chicago and Vicinity."

The leveling process took different forms in different settings, and in some places one or more intermediate mesophytic stages might be attained before the topography finally stabilized as a level plain. Many of the different plants found on different landforms, at the same degree of soil moisture, could be explained as remnants of a previous stage. Thus a hydrophytic plant might be found in a mesophytic soil because it had established itself there years earlier, when the soil was wetter. The history of the landform, as well as the present condition of the soil, had to be taken into account in the study of plant communities. "There must be, then, an order of succession of plant societies, just as there is an order of succession of topographic forms in the changing landscape."[20] "The laws that govern changes in plant societies are mainly physiographic; whether we have broad flood plains, xerophytic hills, or undrained swamps depends on the past and present of the ever-changing topography."[21]

In his third major publication, "The Influence of Underlying Rocks on the Character of the Vegetation,"[22] Cowles grappled with a question that had been a subject of debate among plant geographers through the second half of the nineteenth century. Why did different soils, and by extension different kinds of underlying rocks, have different kinds of vegetation? Was it because of differences in the chemical composition of the soil, or was it rather a result of physical differences such as the coarseness or fineness of a soil, or the amount of water it would hold?

Cowles based his answer on field observations from a variety of locations: Marquette in upper Michigan on Lake Superior, where he had spent several weeks studying the flora with a party of advanced students (see page 44) in the late sum-

mer of 1899; Sturgeon Bay, Wisconsin, possibly visited *en route* to or from Marquette; the Cumberland Mountains of eastern Tennessee, where he had conducted a field class in June, 1900; Long Island, where he had been in charge of botanical work at the Cold Spring Harbor Biological Laboratory later in the summer of 1900; and Connecticut, his home state, perhaps visited in conjunction with his season on Long Island. The second half of the paper included references to the Rocky Mountains of northwestern Montana, where he had led a field party of about twenty men and women to study plant communities near Flathead Lake in August, 1901, after the first installment of the paper was already in print. Cowles also cited views seen from train windows on the way to these locations—east of Port Jarvis, New York, headed toward Connecticut and at Lebanon, Kentucky, on the line from Louisville to Knoxville.[23] He also introduced places nearer home: ravines and outcroppings in northern Illinois, especially at Starved Rock (a location which held special interest for him throughout his career), and the cliffs of eastern Iowa overlooking the Mississippi.

From a detailed comparison of the vegetation on rocks in the various regions under study, Cowles concluded that the differences among them were greatly exaggerated. To describe the pattern they all seemed to follow, he adopted Warming's categorization of plants as xerophytes, hydrophytes, and mesophytes. In every case of the rocks he studied, north or south, granite or sandstone, the first plant to establish itself was the extremely xerophytic lichen. As the rock eroded, dust collected, and the lichens decayed, soil formed in the crevices and moderate xerophytes including mosses and ferns established themselves. As they in turn decayed and produced more soil, xerophytic trees such as pines and junipers began to grow in the crevices. In the resulting shade and moisture, truly mesophytic trees such as maple and beech took hold. Apparent differences in flora among various kinds of rock were to be explained, largely in terms of differences in the rates at which this process took place. Rocks that eroded quickly proceeded from bare rock to mesophytic forest in a comparatively short time, whereas those most resistant to erosion remained at each stage for many years.

In other words, exposed rocks of all kinds have much the same floras; so too when centuries have passed and the rocks are buried underneath a rich humus soil, the conditions will be the same everywhere and the plants, under similar climatic conditions, will be the same. If a sand hill or a clay hill, a granite hill or a limestone hill, have different floras, it is not because of differences in the rock nor of the inor-

ganic soil which comes from it, but it is because one is further along in its life history than is the other. The vegetation that a clay hill has today will be seen on a sand hill in the future centuries. One may sum up these facts as follows: the vegetation of all hills in a given region, of whatever chemical or physical nature, is tending toward an ultimate common destiny, which in most parts of the United States is the mesophytic forest.[24]

In this article, Cowles established the general principle that, at least within a broad climatic zone, the plant communities of virtually every landform and soil type exhibit the same tendency to evolve toward the one kind of community most characteristic of that climate—in much of North America, a mesophytic forest. While his "Ecological Relations" had been local to the Lake Michigan dunes, and his "Physiographic Ecology" had remained limited to the more varied landscape found throughout the greater Chicago area, in his "Influence of Underlying Rocks" he compared flora from Connecticut to Montana, from northern Michigan to Tennessee—and still found that a single pattern held.

In his three major articles of 1899-1901, Cowles laid down the basic, related principles of physiographic ecology and ecological plant succession, as he described a life cycle for all plant communities that was based on topographic succession and tended consistently toward a climax formation. The same three articles firmly established Cowles himself as a known figure within the international community of early twentieth century botanists.

Notes to Chapter 3

1 Cowles, "Ecological Relations," as cited in notes to Chapter II; also reprinted separately in 1899 by the University of Chicago Press; subsequent references are from the article as printed in the *Botanical Gazette*, Feb.-May 1899.

2 Cowles, "Ecological Relations," 95.

3 *Botanical Gazette*, 26, No. 1 (July 1898), 59-60, review of Seward's *Fossil Plants for Students of Botany and Geology*.

4 *Botanical Gazette*, 27, No. 3 (March 1899), 216.

5 *Botanical Gazette*, 27, No. 3 (March 1899), 216.

6 *Botanical Gazette*, 24, No. 1 (July 1897), 68-70.

7 Cowles, "Fifteen-Year Study," 565.

8 Cowles, "Ecological Relations," 100, 186, 194.

9 Cowles, "Ecological Relations," 281.

10 "United States—Great Lakes. Hydrograph of Monthly Mean Levels of the Great Lakes" (Washington, D.C.: U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey [1977]).

11 Cowles, "Ecological Relations," 110.

12 Tansley, "International Phytogeographic Excursion," 324-25.

13 Cowles, "The Economic Trend of Botany," *Science*, NS 41, No. 1050 (12 Feb. 1915), 226.

14 *Botanical Gazette*, 31 Nos. 2, 3 (March, April 1901), 73-108, 145-82; also reprinted separately in 1901 by the University of Chicago Press; also published in modified form by the Geographic Society of Chicago as "The Plant Societies of Chicago and Vicinity"; subsequent references to "Physiographic Ecology" are from the article as printed in the *Botanical Gazette*.

15 *Botanical Gazette*, 33, No. 2 (Feb. 1902), 161, in an obituary Cowles wrote on Schimper's death.

16 Cowles, "Physiographic Ecology," 77.

17 Cowles, "Physiographic Ecology," 178.

18 Cowles, "Physiographic Ecology," 84-85.

19 *Botanical Gazette*, 31, No. 1 (Jan. 1901), 72.

20 Cowles, "Physiographic Ecology," 79.

21 Cowles, "Physiographic Ecology," 178.

22 *Bulletin of the American Bureau of Geography*, 2 (June, Dec. 1901), 163-76, 376-88; reprint (Winona, Minn.: Jones & Kroeger Printers, 1901), 1-26; subsequent references to "Influence of Underlying Rocks" use the page numbering of the Jones & Kroeger reprint.

23 Cowles, "Influence of Underlying Rocks," l; *Botanical Gazette*, 28, No. 3 (Sept. 1899), 223; *Botanical Gazette*, 30, No. 2 (Aug. 1900), 142; *Botanical Gazette*, 32, No. 1 (July 1901), 74-75.

24 Cowles, "Influence of Underlying Rocks," 7.

4

Cowles the Teacher

Cowles remained in the University of Chicago Botany Department for his entire career. He rose from assistant to associate in 1901, instructor in 1902, assistant professor in 1907, associate professor in 1911, and full professor in 1915. In 1925, he became the chairman of the department, and at his retirement in 1934 he was honored with the title professor emeritus.[1] During all those years, following his three groundbreaking publications of 1899-1901, his main influence on the discipline of botany was through personal contacts. First and foremost he was a teacher, both in the classroom and in the field; after 1901, he did comparatively little writing for publication as such. The great majority of his numerous published writings (listed in Bibliography I) were either papers he had presented at professional meetings or else direct outgrowths of his teaching.

As a teacher and colleague he was well liked. He was described as "fair-minded, modest and never at all aggressive,"[2] with a "sense of rightness, of justice."[3] He was said to show "unfailing kindness, good humour and self-sacrifice,"[4] as well as an "infectious enthusiasm" for his subject matter.[5] "From the start he was a remarkably successful teacher ... and he kept the research spirit brightly alive in his classes."[6] Of his personal life apart from the world of botany we know little: by 1911 he was married, and at his death in 1939 he was survived by a widow Elizabeth and a daughter Harriet;[7] but testimonies abound to his personal style of dealing with his botanical protégés and associates. "He devoted himself mainly to his students, rejoicing in their progress and in their subsequent accomplishments."[8] He was said never to forget a student's name,[9] and students and colleagues cherished "his unfailing good humor, his far-famed ability in the telling of a story, his readiness to give ungrudgingly of time and effort in the service of students and friends, his eagerness to discover and

commend whatever is meritorious in the work of a fellow scientist or admirable in the man himself.[10]

Cowles' teaching embodied certain scientific attitudes and habits of thought which he worked hard to convey to his students. For example, he struggled diligently to establish a mechanistic view of the natural world in place of the teleological one which had dominated nineteenth century scientific thought. He objected to language that implied that plants acted with a quasi-human thought for the future; causation, he insisted, must be found in prior events, not in some imagined purpose. This, he said, affected the language that could properly be used to describe evolution, for talk of "adaptation" could mislead the incautious into assuming that species and structures evolve for the purpose of suiting themselves better to their environments.[11] A second recurring theme in Cowles' teaching was his preference for a simple, flexible terminology that could evolve with the growing understanding of the field. "Always supremely enthusiastic in his interests, Cowles was never dogmatic."[12] He realized that highly technical language, fixed ways of organizing knowledge, and overly strict adherence to one arbitrary set of terms could stand in the way of the progress of knowledge.[13]

As the Hull Botanical Laboratory's principal faculty member in ecology, Cowles headed one of the three subdivisions into which the department was organized: morphology, physiology, and ecology. Coulter himself, the department chairman, was in charge of plant morphology (the study of plant structures), an outgrowth of his old interest in taxonomy or classification. Charles Chamberlain was his junior colleague in morphology, following a career path that closely paralleled that of Cowles: instructor 1901, assistant professor 1907 or 1908, associate professor 1911, and full professor 1915.[14] The division of plant physiology (the study of plant functions and organic processes) was under the direction of Dr. Charles Reid Barnes until his accidental death early in 1910. Barnes—Coulter's one-time student (Hanover College, 1870s), long-term friend, and co-editor since 1883 of the *Botanical Gazette*—was chairing the Botany Department of the University of Wisconsin when the Hull Botanical Laboratory first took form at Chicago; Coulter lured him with the opportunity to leave a predominantly undergraduate program for a predominantly graduate one.[15]

Cowles, in charge of ecology, was the youngest and least academically experienced of the men who headed the three divisions of botany at Chicago. Coulter's selection of him for this role was not only an expression of personal confidence, but

also a recognition that ecology, like physiology, was a new field with few practitioners as yet. Dissertation titles of a few of Cowles' early students suggest the directions of his graduate teaching: "The Ecological Relations of the Coniferous Forests of the Flathead Valley, Montana" (Harry Nichols Whitford, 1903); "Reforestation on the Colchester-Essex Sand Plains" (Clifton Durant Howe, 1904); "The Prairie Grass Formation of Southeastern South Dakota" (LeRoy Harris Harvey, 1908); "The Climax Forest of Isle Royale, Lake Superior" (William Skinner Cooper, 1911); "Comparative Anatomy of Dune Plants" (Anna Morse Starr, 1911); "The Physiographic Ecology of Northern Florida" (Laura Campbell Gano, 1912). Most important to Cowles was George Damon Fuller, who completed his Ph.D. in plant ecology and plant morphology in December, 1913, with a dissertation entitled "Evaporation and Soil Moisture in Relation to the Succession of Plant Associations," based on research in the Lake Michigan dunes (See Appendix II). Fuller, who had grown up in the forests of Quebec, was almost exactly Cowles' age; however, he had taught school for a number of years before beginning graduate study and therefore completed his doctorate fifteen years later than Cowles. Much as had happened a generation earlier between Coulter and Barnes, Cowles and Fuller quickly grew from being teacher and student to being colleagues and close friends. Fuller joined the University of Chicago botany faculty in the ecology division, becoming Cowles' assistant and companion. Together they taught classes, led field trips, and explored the dunes of northwestern Indiana.[16]

In practice, there was considerable overlap and cooperation among the morphology, physiology, and ecology divisions of the department. Many students took their degrees in more than one of the fields at once. The faculty worked as a team to offer courses in general botany. For example, Coulter coordinated a "History of Botany" course in which each graduate student or faculty member gave one lecture in his or her specialty; thus Chamberlain and Coulter spoke on topics in morphology, students of Barnes on topics in physiology, and Cowles and his students on topics in ecology. Cowles' contribution to the course was a lecture on "Succession, B.C. 580-A.D. 1896"; among his students, Anna Starr spoke on the history of ecological anatomy, William Cooper on forest ecology, and Laura Gano on coastal plain ecology.[17] In 1910-11, Coulter, Barnes, and Cowles together published a college botany textbook, with three parts reflecting the three divisions of their department, but with a unity in their emphasis—characteristic of the University of Chicago—on fundamental facts and principles, as opposed to a more popular practical and vocational approach.[18]

Cowles also participated in still more broadly based teaching and textbook writing that extended beyond the confines of the Botany Department. When his old geology professors Chamberlin and Salisbury joined forces to write a three-volume opus, *Geology* (1904-06), Cowles contributed an original study in paleoecology, which he also used as the basis for a series of classroom lectures.[19] He contributed to at least two high school textbooks, writing a twelve-page section on "The Response of Plants to Soil and Climate" for Salisbury's *Physiography for High Schools* (1908), and co-authoring with John Gaylord Coulter *A Spring Flora for High Schools* (1915).[20] In 1925, he co-authored with Bertha Morris Parker, *The Book of Plants*, targeting 6th through 8th grade students. Many years later, he joined with leading faculty members from many University of Chicago departments to teach an interdisciplinary survey course about "the nature of the world and of man" for top-ranking freshmen.[21]

As the faculty member in charge of ecology, Cowles spent much of his time conducting field trips so that both he and his students could study plant communities in their natural environments. Some field trips were close to home and lasted only a day; others, to distant parts of the continent, might extend over a period of weeks. Typically, the group would take a train to the station nearest the area they wanted to study, and then hike to the site, sometimes hiking many miles, carrying with them whatever cooking and camping supplies they would need. Cowles combined organizational skill with a sensitivity to student concerns and managed to keep travel costs remarkably low.[22]

The field trips close to home included frequent excursions to the dunes of northwestern Indiana. At first, the principal railroad into the duneland was the Michigan Southern, so the principal destinations for duneland field trips were those places most accessible to the Michigan Southern stations—at Miller, Dune Park, and Chesterton.

> *Miller* is a place of great interest, showing living dunes and the rich aquatic and marsh vegetation of Grand Calumet river to the north, the ancient dunes of the Tolleston beach, Cassandra and tamarack swamps to the south and southeast. *Dune Park* is far the best place to study living dunes in all phases; established dunes and undrained swamps are also well displayed at this point. *Chesterton* is, all things considered, the most interesting place in the vicinity of Chicago, since it shows types of nearly all plant societies . . . all phases of the river series from the ravine to the flood plain; all stages from pond to prairie; all types of dune activity, past and pre-

> sent; and morainic forests. Spring brooks are best shown at this point, also the beech-maple forests.[23]

Field trips might involve considerable walks from these stations, for example, miles separated the Chesterton station from the nearest active dunes.

In 1906-08, the South Shore Electric Line was constructed between Chicago and Michigan City.[24] It greatly improved access to places in the dunes east of Dune Park, near such stations as Baileytown, Oak Hill, Mineral Springs, Tremont (Port Chester), and Furnessville. Cowles' own familiarity with these areas increased markedly; in particular, the moving dunes near Furnessville attracted his attention, although he still continued to find those at Dune Park the most impressive.[25] He and other Chicago professors brought day trips to the dunes as a regular part of their teaching.[26]

Cowles also led field trips further from home. We have seen (pages 28 and 36 above) that he took parties of students on excursions to North Manitou Island, Michigan, in 1898; to Marquette, upper Michigan, in 1899; to eastern Tennessee in 1900 before a season at Cold Spring Harbor, New York; and to Flathead Lake, Montana, in 1901. The long distance field trips continued, at the rate of about one per year. In late March, 1902, together with Professor C. B. Davenport, Cowles led a student group to the Gulf coast of Mississippi; they brought back plant and animal specimens and a number of photographs.[27] That summer, after teaching ecology in the summer botany program at Woods Hole on Cape Cod, he conducted a party of 14 to study the influences of climate, soil, and topography on the flora of Mount Katahdin, Maine, and the Maine seacoast; again, they collected many samples and photographs to supplement their field notes.[28] A year later, in September 1903, Cowles was in Arizona leading a group of students in a study of desert and mountain flora;[29] for a full three months in the summer of 1907, he took a group of 22 students for ecological study in Oregon and Alaska, dividing their time equally between the two states.[30] After George Fuller came to Hull Botanical Laboratory, first as a graduate assistant and then as a faculty member, Cowles and Fuller worked as a team in leading many of the field trips.

Field study was an important part of Cowles' teaching in more ways than one. Its primary function, of course, was to enable both himself and his students to study plants in their natural environments, to observe their relation to topography and climate, to make possible regional comparisons, and to bring the subject matter to life

in a way that could not be achieved with lectures and textbooks alone. However, a second function of the excursions may have been equally important. The rapport that grew among the small group of people who hiked, cooked, and camped together, sometimes for weeks at a stretch, in pursuit of a common interest, was a major factor in the personal influence Cowles exerted on his students and the excitement he was able to arouse in them. They became a mutual support group, almost an extended family, with a kind of closeness that perhaps few graduate departments in other disciplines can equal. The intimacy the students and faculty members developed during their travels, and the affection many of them came to feel for Cowles, personally, surely contributed to the extent to which he was able to inspire the botanists of the next generation. Both in the classroom and in the field, Cowles' direct personal influence on his students was probably the single most significant element, after his initial publications of 1899-1901, in producing the impact he made on the world of botany.

Notes to Chapter 4

1 *Record of Doctors in Botany*, 2; Adams and Fuller, "Henry Chandler Cowles," 42.

2 Adams and Fuller, "Henry Chandler Cowles," 41.

3 Kraus, "Henry Chandler Cowles," 242.

4 Tansley, "International Phytogeographic Excursion," 322.

5 Cooper, "Henry Chandler Cowles," 283.

6 Adams and Fuller, "Henry Chandler Cowles," 39.

7 Cowles, "Notes and Comment," *The Plant World*, 15, No. 2 (Feb. 1912), 46; "Dr. H. C. Cowles, U. of C. Botany Teacher, Is Dead," *Chicago Daily Tribune*, 13 Sept. 1939, p. 16; "Deaths and Funerals. Dr. Henry Chandler Cowles," *Chicago Daily News*, 13 Sept. 1939, p. 30.

8 Adams and Fuller, "Henry Chandler Cowles," 41.

9 Chamberlain, "Henry Chandler Cowles," 3.

10 Cooper, "Henry Chandler Cowles," 283.

11 Kraus, "Henry Chandler Cowles," 241; Cooper, "Henry Chandler Cowles," 283; Cowles in *Botanical Gazette*, 33, No. 1 (Jan. 1902), 70; Cowles in *Botanical Gazette*, 38, No. 2 (Aug. 1904), 148; Cowles, "Present Problems in Plant Ecology. The Trend of Ecological Philosophy," *American Naturalist*, 43, No. 510 (June 1909), 356-68.

12 Adams and Fuller, "Henry Chandler Cowles," 41.

13 *Botanical Gazette*, 32, No. 5 (Nov. 1901), 376; Cooper, "Henry Chandler Cowles," 282; Adams

and Fuller, "Henry Chandler Cowles," 41.

14 *Record of Doctors in Botany*, 1.

15 Coulter, "Address of Professor Coulter: Charles Reid Barnes," 6-8; Cowles, "Charles Reid Barnes," *Science*, NS 31, No. 797 (8 April 1910), 532-33.

16 Paul D. Voth, "Remarks at a Memorial Service for Professor George D. Fuller, November 26, 1961," TS copy in the possession of Dr. Paul Voth, 1-3.

17 Coulter, coordinator, "History of Botany," course outline (1910), TS in the possession of Dr. Paul Voth.

18 Coulter, John Merle, Charles Reid Barnes, and Henry Chandler Cowles, *Textbook of Botany for Colleges and Universities*, 2 vole. (New York, Cincinnati: America Book Company, 1910-11).

19 Adams and Fuller, "Henry Chandler Cowles," 41.

20 Cowles, "The Response of Plants to Soil and Climate," in Rollin D. Salisbury, *Physiography for High Schools* (American Science Series, Briefer Course, 1908), 462-73, as listed among Cowles' works in *Record of Doctors in Botany*, 2; Cowles and John Gaylord Coulter, *A Spring Flora for High Schools* (New York, Cincinnati: American Book Company, 1915).

21 Horatio Hackett Newman, ed., *The Nature of the World and of Man* (Chicago: University of Chicago Press, 1926; 2nd ea., 1927).

22 Chamberlain, "Henry Chandler Cowles," 3; personal information from Dr. Paul Voth and Mrs. Hazel Olmstead as supplied to Dr. J. Ronald Engel in interviews, spring, 1980.

23 Cowles, "The Plant Societies of Chicago and Vicinity," *Bulletin of the Geographic Society of Chicago*, No. 2 (Chicago: The Geographic Society of Chicago, 1901), 75.

24 William D. Middleton, *South Shore, The Last Interurban* (San Marino, Cal.: 1970), 11-21.

25 Cowles, "Fifteen-Year Study," 565.

26 Orpheus Meyer Schantz, "Indiana's Unrivaled Sand Dunes," *National Geographic*, 35 (May 1919), 437-39.

27 *Botanical Gazette*, 33, No. 5 (May 1902), 400.

28 *Botanical Gazette*, 33, No. 4 (April 1902), 320; *Botanical Gazette*, 33, No. 5 (May 1902), 399; *Botanical Gazette*, 34, No. 4 (Oct. 1902), 320.

29 *Botanical Gazette*, 36, No. 3 (Sept. 1903), 238.

30 *Botanical Gazette*, 44, No. 1 (July 1907), 79.

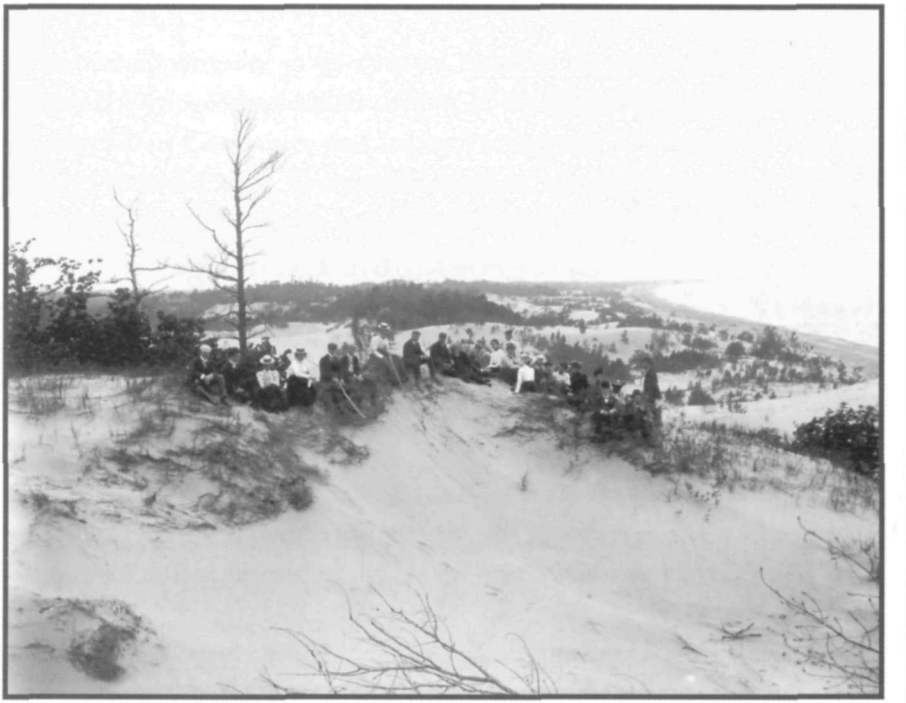

figure 8

A general view of the dunes, Dune Park, Indiana, *c.* 1907. Photographic print; aep-inp22.
[*editor's note:* This photograph is outstanding because of the rare landscape view of the Indiana Dunes at Dune Park where Cowles did much of his research.]

5

An International Phytogeographic Exchange (1911-1913)

In 1911-13, Cowles participated in an international botanical exchange which was one of the high points of his career. It also holds particular interest for us, because it is in the context of this exchange that we find the earliest and most explicit association of Henry Cowles with the wetland that later became known as Cowles Bog.

As we have observed in connection with Cowles' research and teaching, travel to see plants in their native habitats was an integral part of an ecologist's activity. Intercontinental travel had the added advantage of taking the ecologist to places where the climate and overall conditions might be different from those at home, and where plant species might reasonably be expected to differ; it provided the opportunity for comparisons beyond the local level. Travel to Europe held an added attraction for Americans, for Germany was still considered the cradle of scholarly knowledge in general and botany in particular; moreover, study of the great ecologists Drude (*Handbook of Plant Geography*), Warming (*Plantesamfund*), and Schimper (*Plant Physiological Basis*) inspired Americans to want to see for themselves the physical conditions in Denmark, Germany, and other places across the ocean. European botanists, in turn, valued the broadened perspective they could gain from American travel and were intrigued by American botanists' descriptions of New World flora.

Cowles' first known opportunity to go to Europe came in 1905. Early that year, he was appointed (together with Barnes and another botanist) to attend the Second International Botanical Congress in Vienna. It appears that he did not go, however, for Barnes left in April and returned in October without him.[1] Instead, Cowles sailed for Europe in the fall, together with Professor Coulter. Details of their trip are unknown, but it extended over a period of months; they returned to their duties at

the Hull Botanical Laboratory on April 1, 1906.[2]

A second opportunity to go overseas came in the summer of 1911 with the International Phytogeographical Excursion of the British Isles, coordinated by the British Vegetation Committee and led by Professor A. G. Tansley of Cambridge. Participants included seven Continental scholars, among them Oscar Drude, and, from the United States, Cowles and his wife as well as Frederic and Edith Schwartz Clements of Minneapolis. The group met at Cambridge on August 1 and spent the rest of the month in vigorous travel and study. Their itinerary in England included the Norfolk Broads (marshes and fens), the salt marshes and gravel dunes of the Norfolk coast, the Derbyshire dales, dunes at Southport, heaths, and lowland and mountain moors. In Scotland, the group saw the Dunkeld forests and the alpine vegetation of Ben Lawers, and in Ireland they admired the moors, heaths, and mountains about Clifton, the limestone pavements of Ballyvaghn, and the almost tropical forests and arbutus groves of Killarney.[3] At the conclusion of the tour, the group went together to Portsmouth for the meeting (August 31 to September 6) of the British Association for the Advancement of Science, where Cowles presented a paper on his fifteen year study of advancing sand dunes.[4]

Much as he enjoyed observing flora in new settings, Cowles appreciated still more:

> the opportunity of living for a month in intimate relationship with my phytogeographic colleagues of other countries, of knowing them from many points of view, and thus of coming to feel that they are my friends, as well as fellow scientists. This month of living and travelling together made us much better acquainted with each other's views and field interpretations, and also made it possible to read each other's writings much more understandingly than heretofore. Close companionship has made us more sympathetic with opposing viewpoints, and more ready to see at least some truth in views we thought were wholly wrong.[5]

He expressed a strong hope that other international excursions would follow.[6] On their return to the United States, he and Clements set about planning the next one.[7]

The International Phytogeographic Excursion in America materialized in the summer of 1913, with ten European participants, including Tansley who had led the British tour. Before the beginning of the American tour, Cowles asked the Europeans what features of the United States they were most interested in seeing. The lists they sent back varied, but four sites appeared on nearly every list: the Grand Canyon of

the Colorado River, Yosemite, Yellowstone Park, and the Lake Michigan dunes known to them primarily through Cowles' "Ecological Relations" of 1899.[8] Cowles prepared an itinerary to satisfy their interests and to show them a selection of the most ecologically interesting places within the United States.

The Europeans convened in New York during the last days of July. Cowles met them there, as principal organizer and leader; assisting him were George Fuller, just finishing the work for his Ph.D., and George Nichols of New Haven. In New York the group visited the Brooklyn Botanic Garden, the Hempstead Plains prairie on Long Island, the New Jersey pine barrens (resembling European heathland) and salt marshes, the New York Botanical Garden with its primitive hemlock stand, and the Botany Department of Columbia University. Then they boarded a train for Chicago by way of the Erie Canal and Niagara Falls. The last part of the ride to Chicago, on the Michigan Central Railroad, gave them their first glimpse of the dune country. They arrived at the 63rd Street (Woodlawn) station, Chicago, on Friday morning, August 1, and took their luggage to the Gladstone Hotel on 62nd Street before walking the few blocks to the University campus.[9]

The members of the University of Chicago Botany Department welcomed the group in the Hull Botanical Laboratory and took them to a luncheon at the Quadrangle Club. After Coulter offered a few words of greeting in his capacity as chairman, Cowles presented "a short but exceedingly useful lecture on the physiographic and geological features of the Chicago region, indicating their relations to the vegetation and flora."[10] He emphasized the position of the Chicago region as "the meeting-place of a northern and southern flora, and of an eastern and western vegetation."[11]

Two pieces of printed literature supplemented the lectures and field observations for the Chicago portion of the tour. One was the excursion program provided for the entire tour, with a detailed itinerary and field notes for the first week and a half (including the time in and around Chicago).[12] The second was a more detailed program for the Chicago area, "The Vegetation of the Chicago Region," prepared by Fuller specifically for this tour and listing the plant associations to be visited, with locations and lists of characteristic species for each.[13] If the visitors wanted to read still more about the Chicago area in general, Fuller's pamphlet referred them to Cowles' "Physiographic Ecology of Chicago and Vicinity" from 1901; if they wanted to read more about the sand dunes as such, he referred them to Cowles' earlier

article on the sand dune vegetation ("Ecological Relations," 1899) and two of his own more recent publications in the *Botanical Gazette*: one on evaporation (1911) and one on soil moisture (1912). Fuller was joining his mentor Cowles as a principal authority on the plant ecology of the Lake Michigan dunes.[14]

The first afternoon, after lunching at the Quadrangle Club, Cowles took the group by streetcar to see the virgin low prairie at Chicago Lawn. Unlike the great prairies of the American west, this one was not a result of vast climatic effects but rather a particular outcome of succession from a former lake or marsh, left behind when the Calumet stage of Lake Chicago receded.[15]

The next morning, August 2, the group took the Michigan Southern east to Miller (now part of Gary), where they walked across the dunes to Lake Michigan in reverse order of development: the oldest inland oak dunes first, the pine dunes next, and the young cottonwood dunes as they approached the lake. They lunched in the field and returned to Chicago and the Gladstone on the South Shore Electric Line, so as to get a different view from the train windows; no opportunity for ecological observation was to be lost.[16]

On Sunday, August 3, the group went back into the dunes, but this time they penetrated further into Indiana. First, they took the Michigan Southern to the next station beyond Miller, Dune Park, where they visited the large tract of high moving dunes that had always been one of Cowles' favorite sites; they found especially dramatic the view of a moving dune encroaching on a forest and burying it. After lunching in the field, the group took the South Shore further east, riding along the fen-like, former, river valley that lay between the dunes and the Calumet Beach Ridge. They disembarked at Mineral Springs station, where Mineral Springs Road crosses the northern slope of the Calumet Beach Ridge.[17]

Their major interest in going to Mineral Springs was to visit the Mineral Springs Bog. The excursion program is the first specific reference we have met to this wetland. Clearly, Cowles was already familiar enough with it to put it on the excursion program; he had probably discovered it soon after the South Shore Electric Line (constructed 1906-08) began running nearby. The excursion program gave the following description of the wetland:

> The Mineral Springs bog is on one edge of this ancient valley, representing, probably, a former deep hole in the river which persisted long as a pond. There will be seen the stages in bog development from the reed swamp, through the stage of "xerophytic" shrubs to the tamaracks (*Larix*) and the climax forest, the latter only in its initial stages.[18]

Tansley described the visit to Mineral Springs Bog in these terms:

> An interesting tamarack (*Larix laricina*) swamp, developed just behind the dunes, on the edge of an old river valley was visited on August 3rd. Here a succession can be traced from open water (perhaps an old hole in the river-bed that remained as a pond after the river was obliterated) of which practically nothing remains, through reed-swamp and sedge to tamarack wood. The centre of the swamp is now mostly occupied by an association of various species of *Carex* [sedge], including *C. filiformis* and *C. Pseudocyperus*, which are dominant. These are developed on a floating layer of peat through which rise numerous shoots of *Scirpus lacustris* [bulrush] and . . . here and there . . . relicts of the former reed-swamp.[19]

A phase of shrubs, including hoary willow, poison sumac, dwarf birch, and swamp buckthorn, led to a closed canopy wood of tamaracks and yellow birch. The wood also included some red maple and sour gum, and various ferns and starflowers grew on the ground. Despite the occasional appearance of such bog plants as pitcher plant and sundew, the Europeans concluded that this wetland, in general, had many of the characteristics of an English fen, and that its succession pattern seemed to resemble the "Niedermoor" or fen type of succession rather than the "Hochmoor" type, with only local tendencies toward the latter.[20]

Fuller's pamphlet on the Chicago region vegetation supplied yet a third description of the wetland. In keeping with Cowles' usage, Fuller used the term "peat bog" to indicate undrained wetland regardless of what particular plant communities grew there. In the peat bog at Mineral Springs, he described four associations: the sedge, the xerophytic shrub, the tamarack, and the pine-birch forest. Cranberries, bulrushes, and bog goldenrod were among the many plants he listed as part of the sedge association there. A complete copy of his list for the Mineral Springs Bog is attached to this study as Appendix I.

When the excursion group was ready to leave Mineral Springs Bog, the participants took the South Shore Train still further east to Michigan City, where they spent the night. In the morning, they observed a moving dune and an eroding shoreline where the lake was cutting away at a forested dune. They proceeded around the lake

to Three Oaks, Michigan, for a visit to a mesophytic, climax, beech-maple forest [Warren's Woods], and to Sawyer where there were yet more dunes to be seen. From Sawyer they returned to Chicago and its Gladstone Hotel for the night, and most of the next day they relaxed and enjoyed free time in Chicago.[21]

On Wednesday, they spent the day at Starved Rock, where the Illinois River and its tributaries had cut stunning canyons and cliffs in the sandstone. Thursday's expedition was north to the cliffs and ravines of Lake Bluff and Glencoe. On Friday, August 8, the group went to Union Station and took the train westward to Lincoln. After a prairie field trip in Nebraska, they continued west to Colorado to study mountain vegetation; on to Salt Lake City, and then to the sagebrush lands, irrigated fields, conifer forests, and seacoast of Washington state. They visited Mount Rainier, Crater Lake, Yosemite Park, and the California redwoods and salt marshes. By late September they were in the southwestern desert on their way back east.[22]

The significance, to us, of Cowles' involvement in the International Phytogeographic Excursions in the British Isles and America is fourfold. First, his presentation at Portsmouth, England, of a paper about his own dune study certainly contributed to European awareness of and interest in the dunes. This awareness, evidenced by the European scientists' inclusion of the dunes on their lists of areas they most wanted to see in America, was to become one of the arguments used for preserving the duneland as a national park. Second, the detailed documentation which remains to us from the American excursion provides evidence of Cowles' style of field trip planning and leadership; we can see the ways he combined various train routes, scheduled some meals to be taken in the field, incorporated hotels into the schedule as appropriate, and so forth. Third, the American excursion is an early example of the teamwork between Cowles and Fuller, which was to become a significant aspect of Cowles' life and work. Finally, this excursion supplies us with our first and clearest indication of a connection between Cowles and the wetland at Mineral Springs. We not only learn that he considered it worth visiting and took a group there on August 3, 1913; we also learn how he interpreted its origins, what plant associations he found there, what "fen" or "bog" features were present, and specifically what plants were growing there at the time. To the extent that concern about Cowles Bog, on the part of the Indiana Dunes National Lakeshore management, is one of the chief reasons prompting this study of Cowles' life; his visit there in the summer of 1913 must be regarded as one of the central events in this narrative.

Notes to Chapter 5

1 *Botanical Gazette*, 39, No. 1 (Jan. 1905), 79; 39, No. 4 (April 1905), 319; *Botanical Gazette*, 40, No.2 (Aug. 1905), 160.

2 *Botanical Gazette*, 40, No. 2 (Aug. 1905), 160.

3 Cowles, "Notes and Comment," *The Plant World*, 15, No. 2 (Feb. 1912), 46-48.

4 *Report of the Eighty-First Meeting of the British Association for the Advancement of Science* (London: John Murray, 1912) , xxv, xxx; Cowles, "Fifteen-Year Study," 565.

5 Cowles, "The International Phytogeographical Excursion in the British Isles. Impressions of the Foreign Members of the Party," *The New Phytologist*, 11, No. 1 (Jan. 1912), 25-26.

6 Cowles, "International Phytogeographical Excursion in the British Isles," 26; Cowles, "Notes and Comment," 48.

7 Tansley, "International Phytogeographic Excursion," 322.

8 Cowles, "Remarks," in Stephen T. Mather, *Report on the Proposed Sand Dunes National Park, Indiana* (Washington: Government Printing Office, 1917), 43; Tansley, "International Phytogeographic Excursion," 325.

9 Tansley, An International Phytogeographic Excursion," 322-24; Cowles, *International Phytogeographic Excursion Program*, 1-2, 6-9.

10 Tansley, "International Phytogeographic Excursion," 324.

11 Tansley, "International Phytogeographic Excursion," 324.

12 Cowles, International Phytogeographic Excursion Program.

13 George Damon Fuller, *The International Phytogeographic Excursion (I.P.E.) in America 1913: The Vegetation of the Chicago Region* (Chicago: 31 July 1913).

14 Fuller, *I.P.E. in America 1913*, 1.

15 Fuller, *I.P.E. in America 1913*, 8-10; Cowles, *International Phytogeographic Excursion Program*, 2, 10; Tansley, "International Phytogeographic Excursion," 331.

16 Cowles, *International Phytogeographic Excursion Program*, 2, 10; Fuller, *I.P.E. in America 1913*, 1-7.

17 Tansley, "International Phytogeographic Excursion," 328-29; Cowles, *International Phytogeographic Excursion Program*, 2, 10-11.

18 Cowles, *International Phytogeographic Excursion Program*, 11.

19 Tansley, "International Phytogeographic Excursion," 330-31.

20 Tansley, "International Phytogeographic Excursion," 331.

21 Tansley, "International Phytogeographic Excursion," 326-28; Cowles, *International Phytogeographic Excursion Program*, 2, 11-12.

22 Tansley, "International Phytogeographic Excursion," 329; Cowles, *International Phytogeographic Excursion Program*, 2, 3, 13, 14.

figure 9

Cowles and some members of the International Phytogeographical Excursion in the British Isles at Truro, Cornwall, England, 28/29 August 1911. slightly cropped.
Lantern slide by George Damon Fuller; aep-ils411.
[*editor's note:* Cowles with tie and umbrella in hand.]

figure 10

Members of the International Phytogeographical Excursion in America at the Brooklyn Botanic Garden, New York, New York, 27 July, 1913.
Negative by George Elwood Nichols; lantern slide aep-nys2.
[*editor's note:* Cowles is third from right.]

figure 11

Members of the International Phytogeographical Excursion in America on the dunes, Miller, Indiana 2 August 1913.
Glass negative; aep-inn103.
[*editor's note:* Cowles is the third person in the second row, looking to his right.][George Damon Fuller third row left; George Elwood Nichols first row center-*JD*]

6

Beyond the Hull Botanical Laboratory

Cowles' involvement in the International Phytogeographic Excursions illustrates the fact that his life as an ecologist, while based in the Botany Department of the University of Chicago, extended far beyond the confines of the Hull Botanical Laboratory. He attended countless professional meetings in the United States and abroad, presented papers, brought new organizations into being, and held leadership positions in established associations. In addition, increasingly as the years went by, he addressed popular audiences and tried to influence public policy. While his early papers show an exclusive interest in expanding the boundaries of knowledge for its own sake, his later life shows more and more attention to the practical implications of his work for nonscientists.

Cowles participated in, or attended the meetings of, at least a dozen different scientific societies. From the time he joined the faculty at Chicago, he took advantage of and contributed to professional meetings, doubtless with Coulter's encouragement. The naturalists of the Midwest met annually for several years at the University of Chicago, starting in December of 1899, before they established a formal organization; Cowles participated in a symposium on species and base levels in the 1900 meeting, attended that of 1901, and was chosen secretary-treasurer of the Botanists of the Central States when they finally formed themselves into a structured body on March 31 or April 1, 1905.[1] He spoke on ecological cartography (1902),[2] aspects of the species question (1908),[3] and contemporary problems in plant ecology (1909)[4] before the Botanical Society of America, an offshoot of the American Association for the Advancement of Science (A.A.A.S.) which Barnes and Coulter had been instrumental in founding in 1893-94.[5] Before Section G (Botany) of the A.A.A.S. itself, Cowles presented papers in Washington in 1902 and in St. Louis in 1903;[6] during

the St. Louis meeting, he and others held informal discussions which resulted in the creation of the Association of American Geographers.[7] At another A.A.A.S. meeting, in Philadelphia at the end of 1914, Cowles and other plant and animal ecologists initiated yet another organization, the Ecological Society of America, with Cowles as secretary-treasurer, to provide a forum where zoologists and botanists could meet together to share their ecological interests.[8]

On an international scale, the phytogeographic exchange was only one of the many opportunities Cowles took for meeting colleagues from overseas; he presented papers before the International Geographic Congress (Washington, 1904),[9] the British Association for the Advancement of Science (Winnipeg, Canada, 1909; Portsmouth, England, 1911),[10] and the Fourth International Botanical Congress (Ithaca, New York, 1926).[11] Local Chicago and Illinois concerns did not escape his attention either; he was a charter member of the Illinois State Academy of Science and remained active in it as well as in the Geographic Society of Chicago and the Chicago Academy of Sciences.[12] As evidence of his active involvement in these organizations, he held presidencies in many of them: he was president of the Association of American Geographers in 1910, of Section G of the A.A.A.S. in 1913 (after completing a five year term as secretary, 1907-12), of the Ecological Society of America in 1917, of the Botanical Society of America in 1922, of the Chicago Academy of Sciences for some years beginning in 1923, and of the Phytological and Ecological Section of the Fifth International Botanical Congress (Cambridge, England) in 1930.[13] It was in his capacity as president of the Association of American Geographers that he delivered an address on "The Causes of Vegetative Cycles," the published version of which took its place beside his three major journal articles of 1899-1901 as a significant part of his basic statement on physiographic ecological succession.[14]

Had Cowles' only involvements beyond the Hull Botanical Laboratory been in scientific societies, he might have been an important figure only in the history of theoretical science; but his work had practical implications for non-scientists as well, and as the years went by he became increasingly aware of these implications. Cowles' scientific expertise touched on public life in three particular ways: the use of ecological evidence about the past in settling legal disputes, the application of ecological knowledge to the planned management of vegetable resources for human use (as in agriculture and forestry), and the introduction of ecological arguments for preserving natural areas for future generations. Let us look at Cowles' involvement in each of these in turn.

Beyond the Hull Botanical Laboratory

About the end of 1912, the United States Department of Justice called on Cowles to provide ecological evidence in a legal dispute involving the ownership of some Mississippi River bottom land in eastern Arkansas.[15] The original government surveyors there, in 1847, had shown the areas in question as lake; this meant that it could not be sold as farmland, but rather belonged (through riparian rights) to those farmers who bought the land adjacent to the supposed lakes. By the early 20th century, the areas in question were not lake, but highly valuable forest. A lumber company bought the riparian rights from neighboring farmers and began to cut and sell the timber. The Justice Department sued, saying that the original survey had been fraudulent and that, since the supposed lakes had never existed, the neighboring farmers had no rights to the land. Cowles was asked to give testimony.

Cowles had been interested in river bottom succession for some time and had visited the lower Mississippi area twice before. In the course of this study, he visited it four more times. For him, as an ecologist, the job was easy. The timber on the land was very old, too old to be attributed to succession on land that had been open lake in 1847; and as a geologist, Cowles found no trace of recent alluvial accumulation. He testified that the evidence of ecological succession showed beyond any doubt that, even as long as a thousand years before, the areas in question had been land and not water; the survey had indeed been fraudulent. On the basis of Cowles' ecological testimony about the past, the district judge found in favor of the government.

A second way in which Cowles related scientific study to everyday life was "economic botany" or the development of plant resources for human use—the application of theory to practice. Theoretical botanists (in universities) worked with practical botanists (in agricultural and forestry experiment stations) both in field study and in the placement of university graduates. As the number of employment opportunities in agricultural colleges and experiment stations increased and the number in schools teaching only theoretical botany declined, pressures mounted for university departments to make their graduates employable by increasing their "practical" offerings. In an address to the A.A.A.S. at the end of 1914, Cowles acknowledged that private schools such as the University of Chicago were in a better position than state schools to resist the trend, but he questioned whether such resistance was advisable. A purely theoretical department might not attract enough students to sustain its program. Perhaps even private schools should offer sound programs of vocational training, Cowles suggested, in addition to maintaining theoretical study.[16]

As Cowles' name gradually became known beyond university level scholarly circles, he was invited to speak to audiences that were not limited to theoretical botanists. On such occasions, it was natural for him to focus on the "economic" side of botany. At Englewood High School, on November 26, 1920, he addressed a meeting of Chicago area science and mathematics teachers on the subject of "Imported Plants," suggesting increased experimentation with native North American wild plants to learn whether some of them might be of nutritional or other value.[17] In January and February of 1927, he delivered a lecture on "Ecology and Human Affairs" at five locations in Iowa and Minnesota, as part of a Mayo Foundation series on plant pathology and physiology in relation to humans. He pointed out the usefulness of knowing which crops and trees grew best in which kinds of soil, and of being alert to the ecological risks involved in such activities as overgrazing.[18]

A third area of practical activity and public policy to which Cowles turned his attention increasingly over the years was the area of conservation. At the county, state, and national levels, Cowles advocated the creation of parks to preserve places of scenic, historical, recreational, and botanical interest. For the most part, he found these factors eminently compatible. Scenic and historic interest, he recognized, would influence the public more than ecological factors; but the most scenic places (and those least in demand for alternative uses such as farming) tended to be those with a varied topography. Places with varied topography were also those which tended to illustrate the greatest number of stages of succession and therefore held the most interest for the ecologist. Two possible exceptions were prairie and bog, both of which held more interest for the ecologist than for the public at large; Cowles hoped that people could be motivated to save them as well.[19]

In his vigorous activity on behalf of conservation, Cowles considered himself more "rational" than "idealistic." He declared that a "rational conservationist" found it no harder to deal with the cupidity of economic interest groups (such as lumbermen) than with

> "the views of the idealistic conservationist, who lives for the most part well outside the regions of lumber exploitation, and chiefly in our cities. Many lumbermen are too much concerned in immediate gain to take practical thought for the future, and many conservationists are too impractical and too little familiar with forest conditions to be able to deal sanely with things as they are. . . . It must not be forgotten that it is quite as wrong to reserve everything for our descendants, leaving ourselves in want, as it is to appropriate everything for present needs."[20]

At the local level, Cowles was an early advocate of a county forest preserve system, to "furnish places for picnics, and for excursions in connection with the nature study work of the schools . . . Bits of forest here and there would gradually be restored to the primitive wilderness and beauty of the forests of pioneer days.[21] His associates credited Cowles with doing as much as any other single person to bring into existence the Cook County (Illinois) forest preserve system[22]—which, incidentally, came to provide excellent examples of floodplain succession.[23]

At the state level, Cowles spoke strongly in favor of preserving as much land as park, and specified particular areas of interest. A first step of which he wholly approved was taken, before 1912, in the creation of a state park at Starved Rock, a location which had captured Cowles' interest in some of his earliest research and for which he later collaborated in producing a visitors' guidebook.[24] Starved Rock illustrated the principle that places with the greatest scenic beauty and historic interest, and hence the most popular support for preservation, were also likely to be those with the greatest botanical interest in terms of varied plant communities: the park included fine examples of canyon, rock bluff, and floodplain flora. Cowles also first advocated, and later celebrated, the creation of state parks in other locations such as the white pine stand of Ogle County.[25]

On the national level, Cowles advocated the creation of an Indiana Dunes National Park. While he hoped that Illinois would save as parkland its few remaining dunes at Waukegan Flats,[26] he recognized that far more valuable duneland remained in Indiana. The dunes, where he had done his dissertation research, held a special place in Cowles' life, from the time he first went to Dune Park in 1896, until the end of his career. Living near the dunes, he visited the same places again and again, watching them change. When he made trips further away, he studied distant dunes in comparison with those of Lake Michigan. He told an audience on October 30, 1916:

> For 20 years I have been studying the dunes more than anything else, more than everything else combined. In fact, that has been my chief reason for existence, perhaps, for those 20 years. During those 20 years I have studied not only the dunes of Lake Michigan but nearly all the dunes of the world, having personally visited most of them and read about the others.[27]

The audience to whom he spoke was a group assembled to consider the possible creation of an Indiana Dunes National Park. Cowles argued eloquently for the preser-

vation of the duneland "as a common meeting ground of trees and wild flowers from all directions," and "as a picturesque battle ground between plant life and the elements."[28] World War I interrupted the movement to create a national park in the dunes, but after the war, Indiana established a state park there, in part as a result of Cowles' efforts; and in the 1960s and 1970s the national park he had advocated finally came into being.

Eventually Henry Chandler Cowles approached the end of his career. He succeeded Coulter as Botany Department chairman in 1925 and also took over editorship of the *Botanical Gazette*. He continued teaching, with George Fuller at his side. However, illness prevented him from staying fully active either in or out of the department. In 1930, he showed the first signs of Parkinson's disease, and by the end of 1931 he had ceased any effective teaching.[29] George Fuller gradually took over most of his teaching and administrative duties, although Cowles retained the titles of professor and department chairman until his retirement in 1934. At his retirement festivities, his old classmate and later colleague Charles Chamberlain welcomed him to the community of professors emeritus.[30] The following summer, in July, 1935, a special issue of *Ecology* was dedicated to Cowles. In that issue William Cooper (Ph.D. Chicago, 1911) wrote:

> A man may be a great scientist and a great teacher and yet inspire in his colleagues and students little affection or none at all. With Cowles it is far otherwise. Something more than mere respect for high scientific attainment is necessary to account for the fact that, when the plan for this special number of *Ecology* was made public, more than three hundred persons responded. With almost every contribution came a letter expressing admiration for Cowles as a scientist, as a teacher, and, above all, as a man. . . . He has laid the foundation for a new and useful branch of science, he has constructively influenced the thought of hundreds of investigators and teachers, and in his professional and personal contacts he has made for himself a multitude of devoted friends.[31]

Henry Chandler Cowles died at his home on South Blackstone, Chicago a few blocks from the University of Chicago, on September 12, 1939.[32]

Notes to Chapter 6

1 *Botanical Gazette*, 31, No. 1 (Jan. 1901), 72; *Botanical Gazette*, 33, No. 1 (Jan. 1902), 87-88; *Botanical Gazette*, 39, No. 4 (April 1905), 320.

2 *Botanical Gazette*, 34, No. 2 (Aug. 1902), 159.

3 Cowles (with Arthur, Bessey, Britton, Clements, and MacDougal), "Aspects of the Species Question: Ecological Aspects," *American Naturalist*, 42, No. 496 (April 1908), 265-71.

4 Cowles, "Present Problems in Plant Ecology. The Trend of Ecological Philosophy," *American Naturalist*, 43, No. 510 (June 1909), 356-68.

5 Lawrence J. Crockett, "Of Botanical Things Past: Genesis--Part II," *Plant Science Bulletin*, 24, No. 2 (June 1978), 14.

6 Cowles, "Contrasts and Resemblances Between the Sand Dune Floras of Cape Cod and Lake Michigan," *Science*, NS 17, No. 424 (13 Feb. 1903), 262; Cowles, "The Work of the Year 1903 in Ecology," *Science*, NS 19, No. 493 (10 June 1904), 879-85.

7 Adams and Fuller, "Henry Chandler Cowles," 42.

8 Cowles, "A Proposed Ecological Society," *Torreya*, 15, No. 11 (Nov. 1915), 245.

9 *Botanical Gazette*, 38, No. 4 (Oct. 1904), 318-19.

10 Cowles, "The Fundamental Causes of Succession among Plant Associations," *Report of the Seventy-Ninth Meeting of the British Association for the Advancement of Science* (London: John Murray, 1910, 668-70; Cowles, "Fifteen-Year Study," 565.

11 Cowles, "The Succession Point of View in Floristics," *Proceedings of the International Congress of Plant Sciences, Ithaca New York August 16-23, 1926* (Menasha, Wisc.: George Banta, 1929) I, pp. 687-91.

12 Adams and Fuller, "Henry Chandler Cowles," 42.

13 Adams and Fuller, "Henry Chandler Cowles," 42; Chamberlain, "Henry Chandler Cowles," 4; Kraus, "Henry Chandler Cowles," 241; *Botanical Gazette*, 45, No. 3 (March 1908), 216.

14 Cowles, "The Causes of Vegetative Cycles," *Botanical Gazette*, 51, No. 3 (March 1911), 161-83; same text published as Cowles, "The Causes of Vegetative Cycles," *Annals of the Association of American Geographers* (Albany, N.Y.: 1912), I, pp. 3-20.

15 Cowles, "The Economic Trend of Botany," *Science*, NS 41, No. 1050 (12 Feb. 1915), 226-28.

16 Cowles, "Economic Trend of Botany," 223-29.

17 Cowles, "Imported Plants," *School Science and Mathematics*, 21, No. 6 (June 1921), 560-64.

18 Cowles, "Ecology and Human Affairs," in *Lectures on Plant Pathology and Physiology in Relation to Man* (Philadelphia, London: W. B. Saunders Co., 1928), 33-41.

19 Cowles, "Conservation of Our Forests," *Transactions of the Illinois Academy of Science*, 5 (1912), 48-53; Cowles, "Conservation of Illinois Areas of Botanical Value," *Transactions of the Illinois State Academy of Science*, 24, No. 2 (Dee 1931) 86-89.

20 Cowles, "Conservation of Our Forests," 49-50.

21 Cowles, "Conservation of Our Forests," 52.

22 Adams and Fuller, "Henry Chandler Cowles," 42.

23 Cowles, "Conservation of Illinois Areas," 87.

24 Cowles, Carl Ortwin Sauer, and Gilbert H. Cady, *Starved Rock State Park and Its Environs*, Bulletin of the Geographic Society of Chicago, No. 6 (Chicago: University of Chicago Press, 1918).

25 Cowles, "Conservation of Our Forests," 51-52; Cowles, "Conservation of Illinois Areas," 86-87.

26 Cowles, "Conservation of Illinois Areas," 88.

27 Cowles, "Remarks," in Stephen T. Mather, *Report on the Proposed Sand Dunes National Park, Indiana* (Washington: Government Printing Office, 1917), 43.

28 Cowles, "Remarks," in Mather, *Report on Proposed Park*, 44.

29 Personal information from Dr. Paul Voth as supplied to Dr. J. Ronald Engel in an interview, spring, 1980.

30 Chamberlain, "Henry Chandler Cowles."

31 Cooper, "Henry Chandler Cowles," 283.

32 "Dr. H. C. Cowles, U. of C. Botany Teacher, Is Dead," *Chicago Daily Tribune*, 13 Sept. 1939, p. 16; "Deaths and Funerals. Dr. Henry Chandler Cowles," *Chicago Daily News*, 13 Sept. 1939, p. 30.

7

Cowles and Cowles Bog

There are at least three reasons to commemorate the name of Henry Chandler Cowles in the Indiana Dunes National Lakeshore.

First, his crucial work in developing his theory of physiographically-based ecological succession began there, with his doctoral dissertation about the physiography and vegetation of the Lake Michigan dunes. If any one location stood out above the rest in his wide-ranging field work, it was Dune Park, Indiana. The giant sand dunes of Dune Park are no longer there—Bethlehem Steel has a plant where they once stood; but the remaining dunes and wetlands of the surrounding area, now protected as part of the National Lakeshore, were also sites in his lifelong study. His research was important in the history of ecological science, and the duneland was important in his research.

Second, Cowles contributed to the preservation of the dunes and, indirectly, to the creation of the National Lakeshore. His interest in conservation took the form of encouraging the creation of local, state, and national parks, in the dunes and elsewhere. His arguments about the botanical uniqueness of the duneland, and his discovery that (because of his studies there) it was regarded by European ecologists as one of the wonders of the New World on a level with Yellowstone, Yosemite, and the Grand Canyon, were often quoted over the decades to demonstrate the importance of preserving it. The fact that his own research had started in the Lake Michigan dunes strengthened the argument for saving them.

Third, Cowles was indeed the first person known to have drawn attention to the tamaracks and the quaking mat that lie within the present National Lakeshore

boundary to the west of Mineral Springs Road. He took his European visitors there in 1913; he took class after class of students there; he did "so much to make it famous" that the terms "Cowles Tamarack Swamp" and "Cowles Bog" were current by the 1920s. Even though it was the sand hills, rather than the wetland, that first drew Cowles to study in northwestern Indiana, the wetland is the area to which tradition attached his name. The tradition seems worth maintaining, based as it is on a genuine connection between the man and the wetland.

Cowles was fascinated by the remarkable plant communities of the sand hills and wetlands near the southern tip of Lake Michigan. Field study there was at the core of his life, his teaching, his research, and his efforts for conservation. The ecology professor has a fitting memorial in the Cowles Bog National Natural Landmark of the Indiana Dunes National Lakeshore.

figure 12

Swamp with *Betula lutea* (Yellow Birch) and *Osmunda* sp. (Fern). Mineral Springs, Indiana, 1910. Photographic print, aep-inp103. [*editor's note:* Swamp looks much the same today along the boardwalk at the Cowles Bog Trail.]

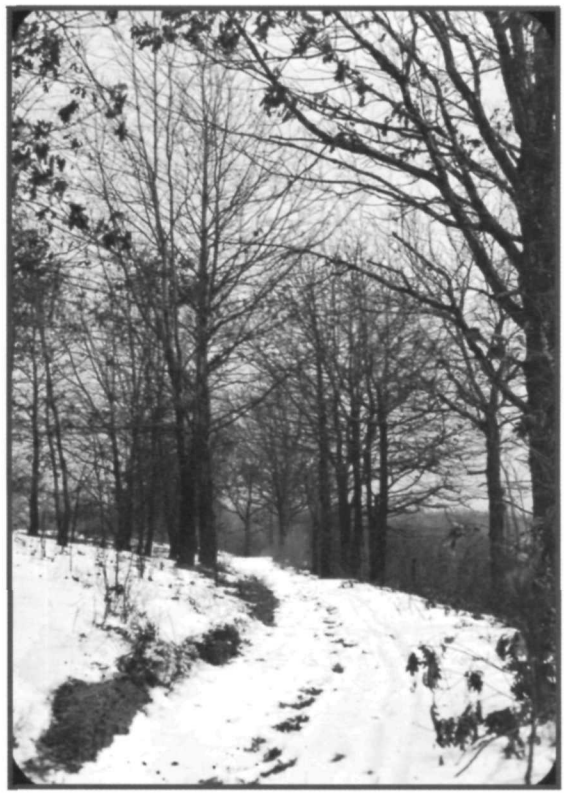

figure 13

A road in winter. Mineral Springs, Indiana, 1 February 1920, lantern slide. Negative and lantern slide by Paul Joseph Sedgewick. [*editor's note:* Tried to relocate this site, to no avail, along the existing Cowles Bog Trail on 15 February, 1999; either destroyed or unrecognizeable.]

APPENDIX I

The Vegetation of the Mineral Springs Bog

This text and list [the fourth of eight plant association series] are taken from *The International Phytogeographic Excursion (I.P.E.) in America 1913: The Vegetation of the Chicago Region*, by Cowles' student and assistant George Damon Fuller (1913), pages 10-12. Words and phrases in square brackets [ ] are additions in Fuller's 1925 revision, *The Vegetation of the Chicago Region* (University of Chicago Press, 1925), pages 17-20; other additions are described in { } brackets. Numbers key the species to the associations of which they are characteristic. Asterisks, used in the 1925 edition only, indicate the most characteristic species of each association.

[It is difficult to know what geographic limits authors imposed on their plant list for Cowles Bog plant communities. The notes below have been appended to imply which species are known from Cowles Bog versus those that probably occurred at the two other sites from which Fuller compiled his 1925 list. Species names in **bold** were noted by Wilhelm (1990) as special vegetation floristic elements of Cowles Bog. Capital letter designations indicate that the species were recorded as follows: "A" for Wilhelm for his "Dune Acres unit A" which surrounds Cowles Bog; "B" for species cited from Hendrickson and Wilcox (1980); and "C" for species cited from Klick (1989). Current scientific names, from Swink and Wilhelm (1994) are given to the right of the equal sign.]

—— IV. THE PEAT BOG ASSOCIATIONS ——

The associations in the peat bog series that are best developed are (1) the sedge, (2) the xerophytic shrub, (3) the tamarack, and (4) the pine-birch forest associations. No separate discussion of the stages in the succession will be attempted but the association in which the following species occur most abundantly will be indicated. These associations are seen at Mineral Springs [and Mill Creek], Ind[iana, and Fox Lake, Illinois].

Trees and Shrubs

(4*) ***Pinus Strobus*** L., white pine.
(4)BC ***Thuja occidentalis*** L., arbor vitae.
(3*)BC ***Larix laricina*** Koch., tamarack or American larch.
(1,2) C ***Salix pedicellaris*** Pursh. [, bog willow.] = *S. pedicellaris* Pursh. var. *hypoglauca* Fern.
(1,2)C " ***candida*** Flugge., hoary willow.
[(2) " *discolor* Muhl., glaucous willow.]
(4)BC ***Betula lutea*** Michx., yellow birch. = *B. alleghaniensis* Britton
(2,3) " ***pumila*** L., dwarf birch. {1925 ed. places it in (4) only }
(2,3) AB *Alnus incana* Moench., hoary alder. = *A. rugosa* (Du Roi) Spreng.
(4)AB *Ulmus americana* L., American elm.
(3,4) A *Rubus hispidus* L., low swamp blackberry.
(3,4) " *villosus* Ait., dewberry.
(3,4) " *triflorus* Richards., dwarf raspberry.
[(3,4)A " *idaeus* L., red raspberry.] = *R. idaeus* L. var. *strigosus* (Michx.) Maxim.
(2*)A *Rosa carolina* L., swamp rose.
(4)A *Pyrus arbutifolia* L., chokeberry. = *Aronia prunifolia* (Michx.) Rehder
(4)A *Amelanchier canadensis* Medic., service-berry. = *A. arborea* (Michx. f.) Fern.
(2*)BC ***Rhus Vernix*** L., poison-sumach.

(2,3) A *Ilex verticillata* Gray., northern-holly.
(2,3) ***Nemopanthus mucronata*** Trel., mountain-holly.
(4*)B *Acer rubrum* L., red maple.
(2,3) C ***Rhamnus alnifolia*** L'Her., swamp buckthorn.
(4)A *Tilia americana* L., basswood or American linden.
(3*)A *Chamaedaphne calyculata* Moench., cassandra.
[(3) *Andromeda polifolia* L., Andromeda.] = *A. glaucophylla* Link
(3,4)A *Vaccinium corymbosum* L., tall blueberry.
(1)A " *macrocarpon* Ait., cranberry.
(2,3)AB *Cornus stolonifera* Michx., red-osier dogwood.
(3)AB " ***canadensis*** L., dwarf dogwood.
(4)A *Nyssa sylvatica* Marsh., sour-gum.
(4)A *Sambucus racemosa* L., red-berried elder. = *S. pubens* Michx.
[(4)AC ***Lonicera dioica*** L., swamp honeysuckle.]

Herbaceous Plants

(3,4)AB *Osmunda regalis* L., royal fern. = *O. regalis* L. var. *spectabilis* (Willd.) A. Gray
(3,4) A " *Claytoniana* L., interrupted fern.
(3,4) AB " *cinnamonea* L., cinnamon fern.
(3*,4)A *Onoclea sensibilis* L., sensitive fern.
(1*,2)AC *Aspidium thylepteris* Sw., swamp fern. = *Dryopteris thelypteris* A. Gray var. *pubescens* (G. Lawson) Nakai
(3,4) " *cristatum* Sw. [, cristate shield fern.] = *Dryopteris cristata* (L.) A. Gray
(2*)A *Woodwardia virginica* Sm., chain fern.
(1)A *Glyceria nervata* Trin. [, manna grass.] = *G. striata* (Lam.) Hitchc.
[(1)A *Zizania aquatica* L., wild rice.]
[(1)A *Dulichium arundinaceum* Britton.{, three-way sedge.}
(1*)C ***Eleocharis rostellata*** Torr., spike-rush.
(1)A " *palustris* (L) R. & S., spike-rush. = *E. erythropoda* Steud.
(1)A *Scirpus validus* Vahl., great bulrush. = *S. validus* Vahl. var. *creber* Fern.
(1)A " *cyperinus* Kunth. [, wool grass]
(1)A " *atrovirens* Muhl. [, dark green bulrush.]
(1)A *Cyperus strigosus* L. [, straw-colored cyperus.]
(1)A " *erythrorhizos* Muhl. {, red-rooted nut sedge}
(1)A " *engelmanni* Steud. {, false rusty nut sedge.}
(1)A *Eriophorum* spp. [1925: *Eriophorum virginicum* L., cotton grass.]
(1)AC *Cladium mariscoides* Torr., twig-rush.
(1)A *Scleria triglomerata* Michx., nut-rush.
(1) *Rynchospora glomerata* (L.) Vahl., beak-rush.
(1)A *Carex trisperma* Dewy. [, soft-leaved sedge.]
(1,3) " *stellulata* Good. [, prickly sedge.]
(1) " *tenella* Schuhr. [, sedge.]
(1) " *crinita* Lam. [, fringed sedge.]
(1) " *filiformis* L. [, slender sedge.]
(1) " *Pseudo-Cyperus* L. [, cyperus sedge.] = *C. comosa* Boott.
[(1)A *Juncus tenuis* Willd., slender rush.]
(3,4) A *Maianthemum canadense* Deaf., wild lily-of-the-valley.
(1,2) AB *Iris versicolor* L., blue flag. = *I. virginica* L. var. *shrevei* (Small) E. S. Anderson
(3) *Cypripedium parviflorum* Salisb., yellow lady's slipper. = *C. calceolus* L. var. *parviflorum* (Salisb.) Fern. {Wilhelm (1990) records ***C. calceolus*** L. var. ***pubescens*** (Willd) Correll from

Cowles Bog}
(2) ***Cypripedium hirsutum*** Mill., showy lady's slipper. = *C. reginae* Walter
(1,2) C " ***candidum*** Mubl., white lady's slipper.
[(4) " ***acaule*** Ait., stemless lady's slipper.]
(1,3) C ***Habenaria hyperborea*** (L.) R. Br., rein orchis. = *H. h.* var. *huronensis* (Nutt.) Farw.
(1,3) A " ***clavellata*** Spreng., rein orchis.
(1,3) A " *ciliaris* R. Br., fringed orchis.
[(1) " *blephariglottis* Torr., white fringed orchis.]
[(1) " *psycodes* Sw., purple fringed orchis.]
(1)A *Calopogon pulchellus* R. Br. {, grass pink.} = *C. tuberosus* (L.} BSP.
(1)A *Spiranthes cernua* (L.) Richards., ladies' tresses.
[(3)A *Pilea pumila* Gray, clear weed.]
[(1)A *Boehmeria cylindrica* Sw., false nettle.]
[(2)AB *Thalictrum dasycarpum* F. & L., meadow rue.]
(1)AB ***Sarracenia purpurea*** L., pitcher-plant.
(2) *Drosera rotundifolia* L., sundew.
(2)A " *longifolia* L., sundew. {omitted in 1925 edition} = *D. intermedia* Hayne
(3) *Saxifraga pennsylvanica* L., swamp saxifrage.
(3) *Chrysosplenium americanum* Schwein., golden saxifrage.
(1)C ***Parnassia caroliniana*** Michx. grass of Parnassus. = *P. glauca* Raf.
(3,4)A ***Coptis trifolia*** Salisb., goldthread.
(2)A *Spiraea salicifolia* L., meadow-sweet. [1925. *Spiraea latifolia* Borkh., meadow-sweet.] = *S. alba* Du Roi
(2)A *Spirea tomentosa* L., hardback. = *S. tomentosa* L. *var. rosea* (Raf.) Fern.
(1)C ***Viola blanda*** Willd., sweet white violet. [1925: *Viola pallens* Brainerd, sweet white violet.]
(1) *Viola lanceolata* L., lance-leaved violet.
[(4)A *Aralia nudicaulis* L., wild sarsaparilla.]
(1*,2)A *Decodon verticillatus* Ell., water-willow.
(4)A ***Trientalis americana*** Pursh., star-flower. = *T. borealis* Raf.
[(3,4)A *Galium triflorum* Michx., sweet-scented bedstraw.]
[(4)A ***Mitchella repens*** L., partridge berry.]
[(3)A ***Myosotis laxa*** Lehm., forget-me-not.]
(3)A ***Linnaea borealis*** L., twinflower.
(1)AB *Solidago patula* Muhl., bog goldenrod.
(1)AC " *neglecta* T. & R., bog goldenrod. = *S. uliginosa* Nutt.
[(1)AC *Aster puniceus* L., bog aster.]
[(1)A *Bidens trichosperma* Britton, tickseed.] = *B. coronata* (L.) Britton

Additional Trees and Shrubs cited from other literature

(4)B *Juniperus virginiana* crebra Fern. & Grisc., eastern red cedar.
(1)A ***Salix sericea*** Marsh., silky willow.
(4)A ***Betula papyrifera*** Marsh., paper birch.
(4)B *Lindera benzoin* (L.) Blume, spicebush.
(3,4)AB ***Rubus pubescens*** Raf., dwarf raspberry.
B *Prunus pennsylvanica* L.f., pin cherry.
(1,2)A ***Vaccinium atrococcum*** (Gray) Heller, black highbush blueberry. = *V. corymbosum* L.
Fraxinus nigra Marsh., black ash.
(2)B *Cephalanthus occidentalis* L., button bush.

Additional Herbaceous Plants

B	*Dryopteris spinulosa* (O.F.Muell.) Watt, spinulose woodfern.
(1)BC	*Typha latifolia* L., common cattail.
(1)B	*Typha angustifolia* L., narrow-leaved cattail.
B	*Triglochin maritima* L., common bog arrow grass.
C	*Bromus ciliatus* L., fringed brome.
(4)A	***Poa paludigena*** Fern. & Weig., bog blue grass.
B	*Phragmites communis* var *berlandieri* (Fourn.) Fern., common reed.
C	*Muhlenbergia frondosa* (Poir.) Fern., marsh wild timothy.
B	*Leersia oryzoides* (L.) Sw., rice cut grass.
(4)A	***Carex bromoides*** Schkuhr., sedge.
(4)A	" *seorsa* Howe, sedge.
C	" ***leptalea*** Wahlenb., sedge.
(1)A	" *limosa* L., sedge.
(1,2)A	" ***atherodes*** Spreng., sedge.
A	" ***hystricina*** Muhl., bottlebrush sedge.
(4)B	*Symplocarpus foetidus* (L.) Nutt., skunk cabbage.
C	*Juncus brachycephalus* Engelm., short-headed rush.
C	*Liparis loeselii* (L.) Richard, green twayblade.
C	*Pilea fontana* (Lunell) Rydb., clearweed.
ABC	***Polygonum arifolium pubescens*** (Keller) Fern., halbert-leaved tear-thumb.
(4)BC	*Clematis virginiana* L., virgin's bower.
(1)A	*Ribes hirtellum* Michx., northern gooseberry.
BC	" *americanum* Mill., black currant.
AC	***Potentilla palustris*** (L.) Scop., marsh cinquefoil.
B	*Rosa palustris* Marsh., swamp rose.
C	*Impatiens capensis* Meerb., orange jewelweed.
C	*Viola cucullata* Ait., hooded violet.
(1)BC	*Gentiana procera* Holm, small fringed gentian.
AC	***Bartonia virginica*** (L.) BSP., screwstem.
B	*Asclepias incarnata* L., marsh milkweed.
B	*Solanum dulcamara* L., nightshade.
C	*Chelone glabra* L., turtle head.
C	*Pedicularis lanceolata* Michx., swamp betony.
(4)AC	***Galium trifidum*** L., small bedstraw.
(1)AC	" ***labradoricum*** Wieg., bog bedstraw.
(1)C	*Lobelia kalmii* L., bog lobelia.
C	*Eupatorium maculatum* L., spotted Joe Pye weed.
B	" *perfoliatum* L., common boneset.
(1)C	*Solidago ohioensis* Riddell, Ohio goldenrod.
(1)C	" *riddellii* Frank, Riddell's goldenrod.
(1)AC	***Aster junciformis*** Rydb., rush aster. = *A. borealis* Prov.
B	*Aster umbellatus* Mill., flat-topped aster.
B	*Cirsium arvense* (L.) Scop., field thistle.

Sources for additional plants known from Cowles Bog

Hendrickson, W. H., and D. A. Wilcox. 1980. Relationships between some physical properties and the vegetation found in Cowles Bog National Natural Landmark, Indiana. Pages 642-666 in National Park Service, editor. Proceedings of the 2nd Conference on Scientific Research in the National Parks; 26-30 November 1979; San Francisco, California. National Park Service, San Francisco.

Klick, K. F. 1988. Proposal for the research burn at Cowles Bog. Unpublished, Department of the Interior, National Park Service, Indiana Dunes National Lakeshore, Porter, IN.

Swink, F. D. and G. S. Wilhelm. 1994. Flora of the Chicago Region Indiana Academy of Science. 921pp.

Wilhelm, G. S. 1990. Special vegetation of the Indiana Dunes National Lakeshore. Indiana Dunes National Lakeshore Research Program Report 90-02, Second Edition. National Park Service, Department of Interior, Omaha, Nebraska.

APPENDIX II

Ph.D.'s in Botany, University of Chicago

The names of students who earned Ph.D.'s in botany through 1934 (the year of Cowles' retirement) are drawn from the University of Chicago, *Announcements: Register of Doctors of Philosophy June, 1893-April, 1938* (Chicago: University of Chicago Press, n.d.), pp. 6-18. Dissertation topics are drawn from an apparently similar, earlier document, through 1921, pp. 53-60, pages of which are attached to Dr. Paul Voth's copy of *A Record of the Doctors in Botany* (Chicago, 1916).

1897 Charles Joseph **Chamberlain**, "Contributions to the Life History of Salix"

1898 William L. **Bray**, "The Xerophytic Flora of the Texas Plains"; Otis William **Caldwell**, "Morphology of Lemna, with Ecological Notes"; Henry Chandler **Cowles**, "An Ecological Study of the Sand Dune Flora of Northern Indiana"; William Dayton **Merrell**, "Contribution to the Life History of Silphium"

1899 Nels L. T. **Nelson**, "Revision of the North American Species of Solanum"; Robert Wilson Smith, "A Contribution to the Life History of Isoetes"

1900 John Gaylord **Coulter**, "A Contribution to the Life History of Sium"; Frank Lincoln **Stevens**, "The Compound Oosphere of Albugo Bliti"

1901 Anstruther Abercrombie **Lawson**, "Studies on the Morphology of the Nucleus"; Burton Edward **Livingston**, "The Development of the Profile of Equilibrium of the Subaqueous Shore Terrace"; Florence May **Lyon**, "The Development of the Sporangium and Gametophyte of Selaginella rupestris"; James Bertram **Overton**, "Parthogenesis in Thalictrum purpurascens"

1902 Theodore Christian **Frye**, "Fertilization and Attendant Phenomena in Asclepias and Acerates"

1903 John Frederick **Garber**, "The Life History of Ricciocarpus natans"; George Mellinger **Holferty**, "The Development and Phylogeny of the Archegonium of Bryum proliferum"; Harry Nichols **Whitford**, "The Ecological Relations of the Coniferous Forests of the Flathead Valley, Montana"

1904 Mintin Asbury **Chrysler**, "The Development of the Central Cylinder in Araceae and Liliaceae"; Clifton Durant **Howe**, "Reforestation on the Colchester-Essex Sand Plains"; William Jesse Goad **Land**, "A Morphological Study of Thuja"; William Burnet **McCallum**, "Regeneration and Polarity in Plants"; George Harrison **Shull**, "A Second Contribution to the Establishment of Place-Constants for Aster prenanthoides Muhl at Clifton, Ohio"; Laetitia Morris **Snow**, "The Effects of External Agents on the Production of Root-hairs"; Robert Bradford **Wylie**, "The Morphology of Elodea canadensis"

1905 Heinrich **Hasselbring**, "Certain Problems of Assimilation"; Etoile Bessie Simons, "A Morphological Study of Sargassum filipendula"

1906 William **Crocker**, "The Role of Seed in Delayed Germination"; Hemming Gerhard **Jensen**, "Toxic Limits and Stimulation Effects of Some Salts and Poisons on Wheat"; Frances Grace **Smith**, "Morphology of the Trunk and Development of the Microsporangum of Cycads"

1907 Lula **Pace**, "Fertilization in Cypripedium"; Reinhardt Thiessen, "The Vascular Anatomy of the Seedling of Dioon"; Shigeo **Yamanouchi**, "A Study of Apogamy"

1908 Leonas Lancelot **Burlingame**, "Staminate Cone of Podocarpus"; Reginald Ruggles **Gates**, "A Study of Reduction in Oenothera Rubrinerois"; LeRoy Harris **Harvey**, "The Prairie Grass Formation of Southeastern South Dakota"; Wanda May **Pfeiffer**, "The Morphology of Leitneria Floridana"; Charles Houston **Shattuck**, "Origin of Heterospery in Marsilia"; Alma Gracey **Stokey**, "The Anatomy of Isoetes"

1909 Sister Helen Angela **Dorety**, "Anatomy of the Seedling of Ceratozamia"; Nielsine Johanna **Kildahl**, "The Morphology of Phyllocladus"; Edith Minot **Twiss**, "Prothallia of Aneimia and Lygodium"

1910 Charles Orval **Appleman**, "Some Observations on Catalase"; Grace Miriam **Charles**, "The Anatomy of the Sporeling of Marattia alata"; Mary Sophie **Young**, "Morphology of the Podocarpineae"

1911 Grace Lucretia **Clapp**, "The Life History of Aneura pinguis"; William Skinner **Cooper**, "The Climax Forest of Isle Royale, Lake Superior"; Sophia Hennion **Eckerson**, "A Physiological and Chemical Study of After-Ripening"; Anna Morse **Star**, "Comparative Anatomy of Dune Plants"

1912 Melvin Amos **Brannon**, "The Action of Salton Sea Water on Plant Tissues"; Laura Campbell **Gano**, "The Physiographic Ecology of Northern Florida"; Stella Mary **Hague**, "A Morphological Study of Diospyros virginiana"; Ansel Francis **Hemenway**, "The Phloem of Dicotyledons"; Lester Whyland **Sharp**, "Spermatogenesis in Equisetum"

1913 Winfred McKenzie **Atwood**, "A Physiological Study of the Germination of Avena fatua"; George Damon **Fuller**, "Evaporation and Soil Moisture in Relation to the Succession of Plant Associations"; John Benjamin **Hill**, "The Anatomy of Six Epiphytic Species of Lycopodium"; Lee Irving **Knight**, "A Study of the Dormancy in Buds of Liriodendron Tulipifera"; John Nathan **Martin**, "Comparative Morphology of Some Leguminosae"; Loren Clifford **Petry**, "The Anatomy of Ophioglossum pendulum"; Norma Etta **Pfeiffer**, "Morphology of Thismia (Bagnisia) americana, n. sp."

1914 Hannah Caroline **Aase**, "Vascular Anatomy of the 'Megasporophyll' in Conifers"; George Smith **Bryan**, "The Archegonium of Sphagnum subsecundum"; Joseph Stuart **Caldwell**, "A Study of the Effects of Certain Antagonistic Solutions upon the Growth of Zea Mays"; Edward Maris **Harvey**, "Some Effects of Ethylene on the Metabolism of Plants"; Florence Anna **McCormick**, "A Study of Symphyogyna aspera"; George Burton **Rigg**, "Decay and Soil Toxins"; Eva Ormenta **Schley**, "Physical and Chemical Changes Involved in Geo-presentation and Geo-reaction"; James Palm **Stober**, "A Comparative Study of Winter and Summer Leaves of Various Herbs"

1915 Hermann Bacher **Deutsch**, "Effect of Light upon the Germination of the Spores of the True Ferns"; Sarah Lucinda **Doubt**, "Response of Plants to Illuminating Gas"; James Frederick **Groves**, "Life Duration of Seeds"; Rachel Emilie **Hoffstadt**, "The Vascular Anatomy of Piper methysticum"; Andrew Henderson **Hutchinson**, "Fertilization in Abies balsamea"; Millard S. **Markle**, "The Root Systems of Certain Desert Plants"; Mabel Lewis **Roe**, "The Development of the Conceptacle in Fucus"; Charles Albert **Shull**, "Measurement of the Surface Forces of Soils"; Arthur Gibson **Vestal**, "The Phytogeography of the Eastern Mountain-Front in Colorado"

1916 Frank Earl **Denny**, "Permeability of Certain Plant Membranes to Water"; Alphaeus William **Dupler**, "The Gametophytes of Taxus canadensis Marsh"; Wright Austin **Gardner**, "The Effect of Light on the Germination of Seeds"; Leslie Alva **Kenoyer**, "Environmental Influences of Nectar Secretion"; George Konrad Karl **Link**, "A Physiological Study of Fusarium in Relation to Potato Disease"; Edith Adelaide **Roberts**, "The Epidermal Cells of Roots"; Earl Edward **Sherff**, "Studies in the Genus Bidens"

1917 Arthur Lawrence **Bakke**, "Studies upon the Determination of Wilting by the Use of Standardized Hygrometric Paper"; John Theodore **Buchholz**, "The Suspensor and Early Embryo of Pinus"; Harold Dudley **Clayberg**, "Physiographic Ecology of Walloon Lake, Petoskey Region"; Winfield Scott **Dudgeon**, "The Morphology of Rumex crispus"; Ezra Jacob **Kraus**, "Vegetation and Reproduction, with Special Reference to the Tomato (Physiological and Horticultural Aspects)"; Henry Reist **Kraybill**, "Vegetation and Reproduction, with Special Reference to the Tomato (Chemical Aspects)"; Wilfred William **Robbins**, "Successions of Vegetation in Boulder Park, Colorado"; Dean Humboldt **Rose**, "Oxidase Activity and Chemical Composition of Healthy and Diseased Apple Bark"; Rial Catlin **Rose**, "Conditions and Microchemistry of Germination of the Seeds of Tilia, Sambucus, and Rubus"; Mandayam A. **Sampathkumaran**, "Stelar Cambium and Its Derivatives"; Homer Cleveland **Sampson**, "Chemical Changes Accompanying Abscission in Coleus Blumei"; Warren Gookin **Waterman**, "The Development of Root Systems under Dune Conditions"; Bertram Whittier **Wells**, "A Survey of the Zoocecidia of Northeastern United States and Eastern Canada"

1918 James Elies **Cribbs**, "A Comparative Study of the Foliar Transpiring Power of Tilia americana"; Arthur Thompson **Evans**, "The Embryo-Sac and Embryo of Penstemon secundiflorus Benth."; Rodney Beecher **Harvey**, "The Hardening Process in Plants and the Developments from Frost Injury"; Henry Albert **Jones**, "Studies on the Seeds of the River Maple (Acer saccharinum L.) and the Sugar Maple (Acer saccarum Marsh)"; Thomas Guthrie **Phillips**, "Physical and Chemical Changes during Geotropic Response"; Frank Milton **Schertz**, "Chemical Studies on the Relation of Nitrogen to Mottling in Coleus"; Harlow Leslie **Walster**, "The Formative Effects of High Temperature upon the Growth of Barley"; Wanda **Weniger**, "Fertilization in Lilium"

1919 Merle Crowe **Coulter**, "Inheritance of Endosperm Characters in Corn"; Arthur Wing **Haupt**, "The Life History of Fossombronia cristula"; LaDema Mary **Langdon**, "The Stem Anatomy of Dioon spinulosum"; Aravilla Meek **Taylor**, "Ecological Succession of Mosses"; John James **Willaman**, "The Function of Vitamine in the Metabolism of Sclerotinia cinerea"

1920 Helen Ashhurst **Choate**, "A Study of Certain Chemical Changes Occurring in Wheat during Germination"; Scott Verne **Eaton**, "Sulphur Content of Soils and Its Relation to Plant Nutrition"; Howard **deForest**, "The Plant Ecology of the Rock River Woodlands of Ogle County, Illinois"; Dean Alvin **Pack**, "After-Ripening and Germination of Juniper Seeds"; Hope **Sherman**, "The Respiration of Dormant Seeds"; Perry Daniel **Strausbaugh**, "A Study of Dormancy in the Plum"

1921 Hugo Leander **Blomquist**, "A Contribution to the Study of the Vascular Anatomy of Angiopteris evecta"; Fred Wilbert **Emerson**, "The Subterranean Organs of Bog Plants"

1922 Sumner Albert **Ives**; Hilary Stanislas **Jurica**; Herman **Kurz**; George Willard **Martin**; Lulu Marie **Newlon**; Eduardo **Quisumbing**; Lillian Grace **Reynolds**; Mary Louise **Sawyer**; Paul Bigelow **Sears**; Paul Joseph **Sedgwick**; Malcolm Cameron **Sewell**; Isabel Seymour **Smith**; Frank Ernest Aloysius **Thone**

1923 Elmer Grant **Campbell**; Georgia Valentine **Coy**; Henry Townsend **Darlington**; Shun Ching **Lee**; John Robert **Magness**; Louise Ella **Rhine**; José Kabigting **Santos**; James Jesse **Turner**; John **Woodward**

1924 Ward B. **Davis**; Robert Barclay **Dustman**; John Hobart **Hoskins**; George Rufus **Johnstone**; Edward Looman **Reed**; Fredda Doris **Reed**; Earle Augustus **Spessard**; Ernest Lincoln **Stover**

1925 James Greenlief **Brown**; John White **Bushnell**; Opal Hart **Davis**; Pansy Alice **Evans**; Basil Elijah **Gilbert**; Walter Ferdinand **Loehwing**; Anne **Norrington**; Sister Mary Ellen **O'Hanlon**; Glen Blaine **Ramsey**; Joseph Banks **Rhine**; Robert Clifton **Spangler**; Selden Richard **Warner**; Frank Aldis **Welton**; Mary **Westall**; Percy White **Zimmerman**

1926 John Morris **Arthur**; Grace **Barkley**; Ching-Yueh **Chang**; Walter Pace **Cottam**; Rollo Othwell **Earl**; Edna Louise **Johnson**; Hiro **Ohashi**; Henry William **Popp**; Mary Minerva **Steagall**

1927 Emma Nathalia **Andersen**; Joseph C. **Ireland**

1928 Bertram Donald **Barclay**; Dorr Raymond **Bartoo**; Dorothy Gladstone **Downie**; Harriet **George**; Arthur Rickenbaugh **Gerhart**; Constance Endicott **Hartt**; Herman Eliot **Hayward**; Harry Colson **Heath**; Kathleen Louise **Hull**; Marion Alvin **Johnson**; Ward L. **Miller**; George Joseph **Raleigh**; Edith **Stevens**; Ophelia C. **Wesley**

1929 Alden Forrest **Barss**; Harry Frank **Clements**; George Lynn **Cross**; John Henry **Davis**, Jr.; Albert Edward **Edgecombe**; Fred William **Geise**; Junetta Christine **Heinonen**; M. Dorisse **Howe**; Elbert Luther **Little**, Jr.; Leon Merle **Pultz**

1930 May **Burunjik**; Stanley Adair Cain; Clytee Rebekah **Evans**; Laurence Frederick **Graber**; Carter Monroe **Harrison**; Harriette Valletta **Krick**; Blanche **McAvoy**; Charles Edgar **Montgomery**; Ray Watson **Rutledge**; Charles Francis **Severin**; Winifred Caroline **Warning**; Herbert Snow **Wolfe**

1931 Clare Francis **Cox**; Frank Patrick **Cullinan**; Ernest Newton **Fergus**; Joseph Harvey **Gourley**; Verne Ovid **Graham**, George West **Graves**; Francisco Mariano **Pagan**; Donald Vincent **Shuhart**; Alda May **Spieth**; Albert Frederick **Thiel**; Lewis MacDonald **Turner**; Henrietta Louise **Zobel**

1932 Alice Allen **Bailey**; William Marshall **Bailey**; Willis Harvey **Bell**; Harris Miller **Benedict**; Robert Samuel **Campbell**; Seville **Flowers**; Sylvia May **Griswold**; Charles Andrew **Hoffman**; William Grovenor **McGinnies**; John William **Mitchell**; Thora Marggraff **Plitt**; Hazel Marguerite **Schmoll**; Richard Arthur **Studhalter**; Harold Bradford **Tukey**; Charles **Whitfield**; Tsu Kiang **Yen**

1933 Herbert Wesley **Conner**; Donald Mundell **Crooks**; Helen **Dixon**; Mildred Elizabeth **Faust**; Thomas Jewell **Harrold**; Clyde **Homan**; John **Voss**, Jr.; Paul Dirks **Voth**

1934 Orlin **Biddulph**; David Francis **Costello**; Ulys Roy **Gore**; Worthy Harold **Horr**; John Flowers **Locke**; Naomi **Mullendore**; Ernest Hocking **Runyon**; Gustav Bennett **Ulvin**; Harvey Oscar **Werner**

APPENDIX III

Partial Chronology of Cowles' Life

Sources are Cowles' writings and speeches (Bibliography I), obituaries (Bibliography II), and brief notices in the *Botanical Gazette.*

1869	Feb. 27	Born in Kensington, Connecticut
1870s 1880s		Attended Kensington public schools and New Britain High School, Connecticut
1893		Received B.A., Oberlin College, Ohio; chief interests in college taxonomic botany, local distribution of plants, geology; studied Latin and Greek for a total of 7 years
1894-95		Taught natural science at Gates College, Nebraska
1895		Received fellowship to study geology at the University of Chicago for academic year 1895-96; studied Pleistocene paleobotany with Rollin D. Salisbury and Thomas C. Chamberlin
1896		Observed Indiana Dunes for the first time, at Dune Park, Indiana; began studying dune vegetation)
	December	Published his first review in the *Botanical Gazette*
1897	Summer	Spent time in Michigan, traveling up and down the east shore of Lake Michigan
	Autumn	Became assistant to John M. Coulter in Botany Department as it was first becoming organized
	Nov.	Drove in a stake at the base of a rapidly advancing dune at Dune Park, to measure rate of movement
1898	April	Received Ph.D. in Botany and Geology, University of Chicago
	May	Checked stake at Dune Park, found it nearly covered
	Late Summer	Led field class of 12, for 6 weeks, for study on North Manitou Island, Michigan; probably also spent some of that time on Beaver Island, and perhaps also some on Mackinac
1899	Feb., March, April, May	Published a modified form of his dissertation in the *Botanical Gazette*
	Late Summer	Spent several weeks at Marquette, Michigan, with a party of advanced students, studying the flora
	December	Probably attended first meeting of Central States Naturalists at the University of Chicago

1900	June	Conducted a field study class through the Tennessee mountains
	Summer	Was in charge of botanical work at Cold Spring Harbor Biological Laboratory, Long Island, New York
	Dec. 27-28	Conducted symposium, with H. N. Whitford and C. C. Adams, on base levels and species differentiation, at 2nd meeting of Central States Naturalists, at University of Chicago
1901	Feb., March	Published "Physiographic Ecology of Chicago and Vicinity" in the *Botanical Gazette*
	after March	Published essentially the same paper for the Geographic Society of Chicago, somewhat popularized
	August	Conducted field party of about 20 to study ecology in northwestern Montana, especially at Flathead Lake
	June, Dec.	Published paper on effects of underlying rocks on vegetation, in American Bureau of Geography bulletin
		Was promoted from "assistant" to "associate" in Botany
1902	Dec. 31-Jan. 1, 2	Attended 3rd annual meeting of Central States Naturalists at University of Chicago
	February	Was named to take charge of special phytogeography department of incipient *Journal of Geography*
	Late March	Conducted student group to Gulf coast of Mississippi, with C. B. Davenport as co-leader
	July 1 or 2	Presented illustrated paper on ecological cartography, comparing ocean and lake dunes, at Pittsburgh at 8th annual meeting of Botanical Society of America
	Summer	Taught ecology in botany program at Woods Hole, Massachusetts
	Late Summer	Conducted party of 14 to Mount Katahdin and the coast of Maine
		Was promoted from "associate" to "instructor" in Botany
1902	Dec. 30-31	Presented two phytogeographical papers in Washington, D.C., one to the American Association for the Advancement of Science (A.A.A.S.), Section G (Botany), and the other for the related meeting of the Society for Plant Morphology and Physiology
1903	September	Was in Arizona conducting a University of Chicago field party studying desert and mountain flora (26)
	Dec. 29	Presented paper about recent work in ecology to A.A.A.S. in St. Louis; in course of same meetings, participated in small group discussion which brought into being the Association of American Geographers
1904	March	Was in Florida studying the Everglades, sent by Botany Department, using the U.S. Subtropical Laboratory at Miami as a base

	April	Visited the Apalachicola River region, Florida, between the Georgia border and about 30 miles south of the border, especially west of Chattahoochee; studied *Torreya taxifolia* Arnott; collected staminate and ovulate specimens April 4 and 5, and arranged for further specimens to be sent back until October
	Sept. 8-10	Presented paper on Apalachicola region at 8th International Geographic Congress, Washington, D.C., and had another paper "read by title"
1905	Before April	Was appointed, with Barnes and Shear, to go to Vienna for 2nd International Botanical Congress; apparently did not go, however
	March 31 or April 1	Was elected secretary-treasurer of the Botanists of the Central States as they formed organization
1905-06	Autumn -Winter	Spent fall and winter in Europe with John M. Coulter
1906	April 1	Returned from Europe, with Coulter; resumed teaching
	Autumn-Early Winter	Studied the Everglades, Florida, under a Carnegie Institution Grant
1907	May or earlier	Was promoted from "instructor" to "assistant professor"
	June 20-September	Spent 6 weeks in Oregon and 6 weeks in Alaska, with 22 students, in ecological study
1908	Dec. 30, 31 -Jan. 1	Attended Chicago meeting of A.A.A.S.; was elected to 5 year term as secretary of Section G (Botany); on Jan.1 participated in symposium on species at related meeting of the Botanical Society of America
1908 1909	Late Dec.-Early Jan.	Spoke on present trend of plant ecology at Baltimore meeting of the Botanical Society of America
	Aug. 27	Spoke on causes of succession, in Winnipeg at meeting of British Association for the Advancement of Science
1910		Was president of the Association of American Geographers
	Autumn	Lectured on succession in "History of Botany" course
	Dec. 29	Attended Pittsburgh meeting of the Association of American Geographers, as outgoing president, and gave presidential address on vegetative cycles)
1911		Published Vol. II ("Ecology") of college level botany textbook prepared with Coulter and Barnes
		Was promoted from "assistant professor" to "associate professor"
	August	Traveled through Britain on International Phytogeographical Excursion
	August 31	Delivered paper in Portsmouth, England, to British Association for the Advancement of Science

1912	Feb. 23-24	Participated in symposium on conservation at Bloomington, Illinois, for state science academy
1913	About Dec. or later	Testified for Justice Department in case on Mississippi River bottoms in 1913 Arkansas, after making four trips
		Was vice-president of A.A.A.S. for Section G (Botany)
	July 27 - Sept. 24	Conducted International Phytogeographic Excursion in America
	August 3	Took excursion group to wetland at Mineral Springs
	August 6	Took excursion group to Starved Rock
1914	December	Attended A.A.A.S. meeting in Philadelphia; presented paper on economic botany; on Dec. 30, met with others to form the Ecological Society of America and was elected secretary-treasurer
1915		Was promoted from "associate professor" to "professor"
		Published *A Spring Flora for High Schools* with John Gaylord Coulter, Ph.D. Chicago 1900 in Botany & Geology
1915	Dec. 28-30	Probably attended A.A.A.S. meeting in Columbus, Ohio, and participated in organizational meeting of Ecological Society of America as announced after its 1914 preliminary gathering
1916	Oct. 30	Spoke at a public hearing in Chicago in favor of proposed dunes national park
1917	Dec. 28-31	Attended Pittsburgh meeting of Ecological Society of America; was
1918	Jan. 1	elected president of it; presented paper on succession in Arkansas sunk lands
		Published Starved Rock State Park visitor guidebook with Sauer and Cady
1920	Nov. 26	Spoke at Englewood High School to science and mathematics teachers on "Imported Plants"
1922		Served as president of the Botanical Society of America
1923		Received honorary Doctor of Science degree from Oberlin College, Ohio
		Became president of the Chicago Academy of Sciences
1925		Became chairman of the University of Chicago Botany Department, succeeding Coulter
1926		Became editor of the *Botanical Gazette*

1926	August 20	Spoke on succession at Ithaca, New York, to 4th International Congress of Plant Sciences Met repeatedly with 15 fellow instructors in freshman survey course, "Nature of World and Man," to develop their lectures into a book)
1927	Jan. 31 - Feb. 4	Lectured on practical ecology in a Mayo-sponsored series at 5 locations
	Dec. 29	Spoke in Nashville, Tennessee, on prairies to the Ecological Society of America
1930	Aug. 16-23	Attended the International Botanical Congress (the fifth) in Cambridge, England, and chaired the phytogeography and ecology section
		Developed Parkinson's disease; began to withdraw from teaching and administrative duties
1931		Ceased effective teaching because of Parkinson's disease
1932	Spring	Gave a radio talk on "the ever-changing landscape" in a science series on the Columbia Broadcasting System
1934	Summer?	Retired as professor and chairman of University of Chicago Botany Department, at age 65, and became professor emeritus; also retired as editor of the *Botanical Gazette*
1935	July	Was honored by special issue of Ecology dedicated to him
1939	Sept. 12	Died at his home at 5779 South Blackstone, Chicago, leaving a widow Elizabeth and a daughter Harriet
	Sept. 14	Was honored in a memorial service at Bond Chapel, University of Chicago, at 2 p.m

APPENDIX IV

Schedule of Henry Chandler Cowles Symposium

Symposium was held in 1983 at the annual meeting of the Ecological Society of America at the University of North Dakota, Grand Forks on August 11. It was sponsored by the Historical Records Committee of the ESA and organized by Elbert L. Little and Robert L. Burgess. Schedule is taken from the Bulletin of the Ecological Society of America, vol. 64 (2): 183-184.

HENRY CHANDLER COWLES MEMORIAL SYMPOSIUM:
50 Years After his Retirement

1:15 Burgess, Robert L. The legacy of Henry Chandler Cowles.

1:25 Little, Elbert L. Henry Chandler Cowles: biography and bibliography.

2:00 Voth, Paul D. Botany at the University of Chicago: 1900-present.

2:15 McGinnies, William G. The final years, 1925-1933.

2:30 Olson, Jerry S. Ecology at the University of Chicago, 1950-1970. Physiographic ecology revisited.

2:45 Teeri, James A. Ecology at the University of Chicago, 1970-oresent.

3:00 Recess

HENRY CHANDLER COWLES AND THE SCIENCE OF ECOLOGY:
Vignettes from the Past

3:15 Sears, Paul D.

3:25 Faust, Mildred Elizabeth

3:35 Campbell, Robert

3:45 Castello, Robert

3:55 Barclay, Harriet George

4:05 Cottam, Walter P.

4:15 Burgess, Robert L. Henry Chandler Cowles and the history of American ecology. A synthesis and summary of the symposium.

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Cowles' Writings and Speeches

1896+ Assorted items. The *Botanical Gazette*, 22, No. 6 (Dec. 1896) ff.

A variety of brief reviews, notices, etc. in almost every volume of the journal over a period of decades, starting with the December 1896 issue. Cowles became editor in 1926.

1897 "Lectures on Ecology." The College Endowment Association, Science Section, 1897.

A six page outline of six lectures, with exercises and references, apparently used by Cowles in his earliest teaching; Cowles' name is not printed on the outline, but the copy in Dr. Paul Voth's possession bears his autograph and the title is included in Dr. Voth's duplicated list of Cowles reprints. Lectures concern the effects on vegetation of light, heat, air, water, and soil.

1898 "An Ecological Study of the Sand Dune Flora of Northern Indiana." Diss. University of Chicago, 1898.

Dissertation for Ph.D. in both botany and geology. The original dissertation is not identical with the published form, listed immediately below.

1899 "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan." *Botanical Gazette*, 27, Nos. 2, 3, 4, 5 (Feb., March, April, May 1899), 95-117, 167-202, 281-302, 361-91.

Published version of Cowles' dissertation, published under the head "Contributions from the Hull Botanical Laboratory." It was also reprinted separately in 1899, in the same format as for the *Botanical Gazette*, by the University of Chicago Press. The thesis examines the sand dunes from a physiographic viewpoint, with attention to their vegetation and to changes over time.

1901 "The Physiographic Ecology of Chicago and Vicinity; a Study of the Origin, Development, and Classification of Plant Societies." *Botanical Gazette*, 31, Nos. 2, 3 (March, April 1901), 73-108, 145-82.

Two-part article, more comprehensive than Cowles' previous work on the dunes. The article attempts to systematize the study of ecology, naming and describing categories of plant communities in relation to topography and illustrating with examples from the greater Chicago area. It was also reprinted separately in 1901 by the University of Chicago Press.

1901 "The Plant Societies of Chicago and Vicinity." *Bulletin of the Geographic Society of Chicago*, No. 2. Chicago: The Geographic Society of Chicago, 1901.

Modified version of "The Physiographic Ecology of Chicago and Vicinity," revised for separate publication by the Geographic Society of Chicago and published later in the year than the *Botanical Gazette* version. The second half of the introduction and the entire body of the paper is identical in the two versions; the first part of the introduction is different, and is shorter in "Plant Societies" with less review of the scientific literature. "Plant Societies" omits the "Summary and Conclusion" of "The Physiographic Ecology of Chicago and Vicinity" and substitutes an appendix, "The Principal Localities about Chicago for the Study of Plant Societies," with descriptions of locations in connection with the railroads or streetcar lines by which they could be reached.

1901 "The Influence of Underlying Rocks on the Character of the Vegetation." *Bulletin of the American Bureau of Geography*, 2 (June, December 1901), 163-76, 376-88.

Two-part article; also reprinted separately under the same title, but with pages numbered 1-26 (Winona, Minn.: Jones & Kroager Printers, 1901). Cowles studies vegetation patterns on different kinds of rock and finds a tendency in all cases to change toward mesophytic forest. A review and brief summary by Harry Nichols Whitford appears in the *Botanical Gazette*, 33, No. 4 (April 1902), 316.

1902 "Contrasts and Resemblances Between the Sand Dune Floras of Cape Cod and Lake Michigan." *Science*, NS 17, No. 424 (13 Feb. 1903), 262.

Abstract of paper presented Dec. 30 or 31, 1902, in Washington, D.C., to the American Association for the Advancement of *Science*, Section G (Botany). Cowles concludes that the resemblances between Cape Cod and Lake Michigan floras exceed the differences.

1902 "The Contribution of Linnaeus and His Students to Phytogeography." *Science*, NS 17, No. 429 (20 March 1903), 463-64.

Abstract of paper presented Dec. 30 or 31, 1902, in Washington, D.C., to the Society for Plant Morphology and Physiology, meeting in conjunction with the American Association for the Advancement of Science and the American Society of Naturalists.

1903 "The Work of the Year 1903 in Ecology." *Science*, 19, No. 493 (10 June 1904), 879-85.

Paper presented Dec. 29, 1903, at St. Louis, to the American Association for the Advancement of Science, Section G (Botany), on a topic assigned by the section committee. Cowles surveys major ecological writings and studies of 1903, with special attention to theories of adaptation and evolution.

1904 "A Remarkable Colony of Northern Plants along the Apalachicola River, Florida, and Its Significance." *Report of the Eighth International Geographic Congress*. Washington: Government Printing Office, 1905. P. 599.

Abstract of paper presented Sept. 8, 9, or 10, 1904, in Washington, D.C., to the Eighth International Geographic Congress, with a brief note of discussion by another participant. Cowles presents the Torreya as a northern mesophytic plant left stranded in Florida as a relic of an earlier plant community.

1904 "Importance of the Physiographic Standpoint in Plant Geography." *Report of the Eighth International Geographic Congress*. Washington: Government Printing Office, 1905. P. 600.

Abstract of paper "read by title" Sept. 8-10, 1904, in Washington, D.C., at the Eighth International Geographic Congress. The paper argues that a physiographic approach helps clarify the life histories of plant associations and provides a simple basis for classification.

1906? "Picturesque Savanna." Chicago: Chicago, Milwaukee & St. Paul Railway (Series No. 31), n.d.

Fifteen-page illustrated promotional booklet, apparently one of a series depicting sites people might visit by train. While the booklet is undated, it identifies Cowles as "instructor," a title he held from 1902 to early 1907; the copy at the Chicago Historical Society has penciled "1/5/09," perhaps an acquisition date. Cowles describes the geological, botanical, and scenic interest of the Savanna, Illinois, vicinity.

1908 "Aspects of the Species Question: Ecological Aspects." *American Naturalist*, 42, No. 496 (April 1908), 265-71.

Part of six-participant symposium presented Jan. 1, 1908, at Chicago, to the Botanical Society of America; other participants are Bessey, Britton, Arthur, MacDougal, and Clements. Cowles urges that taxonomy should be scientific, rigorous, and standard worldwide.

1908 "The Response of Plants to Soil and Climate." In *Physiography for High Schools*, by Rollin D. Salisbury. American Science Series, Briefer Course, 1908. Pp. 462-73.

Section within high school textbook. This is listed among Cowles' works in the *Record of the Doctors in Botany* presented to Coulter in 1916. The textbook is listed in the Library of Congress catalogue, but we have not succeeded in locating a copy within the Chicago area.

1909 "Present Problems in Plant Ecology. The Trend of Ecological Philosophy." *American Naturalist*, 43, No. 510 (June 1909), 356-68.

Paper presented late Dec., 1908, or early Jan., 1909, in Baltimore, to the Botanical Society of America; apparently one of a series. Cowles opposes teleological language. Discussion follows.

1909 "The Fundamental Causes of Succession among Plant Associations." *Report of the Seventy-Ninth Meeting of the British Association for the Advancement of Science*. London: John Murray, 1910. Pp. 668-70.

Paper presented Aug. 27, 1909, at Winnipeg, Manitoba, to the British Association for the Advancement of Science. Cowles lists a variety of factors that encourage succession, often in combination; only in a climax formation is stability possible.

1910 "Charles Reid Barnes." *Science*, NS 31, No. 797 (8 April 1910), 532-33.

Obituary, with a summary of Barnes' life and his major contributions to botany.

1910 "Succession, B.C. 580 - A.D. 1896." TS in the possession of Dr. Paul Voth.

One-page lecture outline from "History of Botany" course given in the autumn of 1910, at the University of Chicago, taught by members of the Botany Department and coordinated by Coulter. Cowles traces the history of ideas related to plant succession, starting with early belief in sudden creation and concluding with the work of Warming and others in the 1890s.

1910 "The Causes of Vegetative Cycles." *Botanical Gazette*, 51, No. 3 (March 1911), 161-83. Also in *Annals of the Association of American Geographers*. Albany, N.Y., 1912. Vol. 1, pp. 3-20.

Paper presented Dec. 29, 1910, at Pittsburgh, to the Association of American Geographers, in Cowles' capacity as retiring president. The two printed versions are identical. Cowles says that different causes of vegetational cycles operate at different speeds; for instance, cycles of climate operate slowly and may each take in several shorter cycles of erosion.

1911 *Textbook of Botany for Colleges and Universities, Vol. II: Ecology*. New York, Cincinnati: American Book Company, 1911.

Second volume of undergraduate level university textbook written with John Merle Coulter and Charles Reid Barnes, who together wrote the first volume (1910) on morphology and physiology. The text, based on the teaching experience and needs of the University of Chicago Botany Department, emphasizes basic facts and principles, as opposed to popular vocational

aspects of botany.

1911 "A Fifteen-Year Study of Advancing Sand Dunes." *Report of the Eighty-First Meeting of the British Association for the Advancement of Science.* London: John Murray, 1912. P. 565.

Abstract of paper presented Aug. 31, 1911, at Portsmouth, Eng., to the British Association for the Advancement of Science, Section K (Botany). Cowles describes his extended study of advancing high dunes at Dune Park, Furnessville, and Glen Haven.

1912 "Conservation of Our Forests." *Transactions of the Illinois Academy of Science*, 5 (1912), 48-53.

Part of symposium on conservation presented Feb. 23-24, 1912, at Bloomington, Ill., to the Illinois Academy of Science. Cowles advocates forest preservation in both state parks and county forest preserves.

1912 "The International Phytogeographical Excursion in the British Isles. Impressions of the Foreign Members of the Party." *The New Phytologist*, 11, No. 1 (Jan. 1912), 25-26.

Statement of appreciation for the effect of the August, 1911, excursion in bringing better understanding among scientists from various countries.

1912 "Notes and Comment." *The Plant World*, 15, No. 2 (Feb. 1912) 46-48.

Summary of the itinerary of, and list of participants in, the August, 1911, International Phytogeographical Excursion in the British Isles.

1913 *The International Phytogeographic Excursion (I.P.E.) in America. 1913. Excursion Program. First Section—New York to London.* July 24, 1913.

Sixteen-page detailed itinerary, excursion notes, and list of personnel for the excursion, with greatest detail for the New York to Lincoln part of the tour and summary for the remainder; prepared for the use of excursion participants.

1914 "The Economic Trend of Botany." *Science*, NS 41, No. 1050 (12 Feb. 1915), 223-29.

Paper presented late Dec., 1914, in Philadelphia, to the American Association for the Advancement of Science. Cowles discusses applied botany, as illustrated in uses for agriculture, forestry, and other fields.

1915 *A Spring Flora for High Schools.* With John Gaylord Coulter. New York, Cincinnati: American Book Company, 1915.

Textbook with descriptions and illustrations of plants.

1915 "A Proposed Ecological Society." *Torreya*, 15, No. 11 (Nov. 1915), 245.

Announcement of the formation of an American Ecological Society at the preceding American Association for the Advancement of Science (A.A.A.S.) meeting and open invitation for interested people to attend a formal organizational session at the forthcoming A.A.A.S. meeting.

1916 "Remarks." In *Report on the Proposed Sand Dunes National Park Indiana*, by Stephen T. Mather. Washington: Government Printing Office, 1917. Pp. 43-46.
Speech presented Oct. 30, 1916, at Chicago, in a hearing on the sand dunes national park

proposal. Cowles advocates preservation of the dunes as a park because of their botanical importance, their size compared to dunes elsewhere, their fame among European scientists, and their spectacular wildflowers.

1917 "Retrogressive and Progressive Successions in the Arkansas Sunk Lands." *Journal of Ecology*, 6 (1918), 95-96.

Abstract of paper presented between Dec. 28, 1917, and Jan. 1, 1918, at Pittsburgh, to the Ecological Society of America. Cowles discusses the sudden retrogression in vegetation caused by an extensive sinking of the earth's crust connected with the earthquake of 1811.

1918 *Starved Rock State Park and Its Environs.* With Carl Ortwin Saner and Gilbert H. Cady. Bulletin of the Geographic Society of Chicago, No. 6. Chicago: University of Chicago Press, 1918.

Study of the Starved Rock region, designed for the use of park visitors. It has three parts: geography (Saner), geology (Cady), and botany (Cowles).

1920 "Imported Plants." *School Science and Mathematics*, 21, No. 6 (June 1921), 560-64.

Paper presented Nov. 26, 1920, at Englewood High School, Chicago, to the biology section of the C.A.S. & M.T., an organization of science and mathematics teachers. Cowles argues that most of our crop plants came with immigrants from their homelands, but that it is now time to experiment with the crop possibilities of plants indigenous to the United States.

1925 *The Book of Plants.* With Bertha Morris Parker. Cambridge, The Riverside Press, 1925.

Readings for 6th through 8th grade students concerning plants.

1926 "Interactions Between Plants and Their Environment." *The Nature of the World and of Man*, ed by Horatio Hackett Newman. Chicago: University of Chicago Press, 1926; 2nd ea., 1927. Chap. 9.

Chapter based on lecture in a University of Chicago survey course offered each year for top-ranking first year students; the course was directed by Newman and taught by sixteen instructors whose chapters make up this book. The entire book is oriented toward evolution; Cowles concludes that evolution has brought all plants and animals to one vast symbiosis.

1926 "The Succession Point of View in Floristics." *Proceedings of the International Congress of Plant Sciences, Ithaca, New York, August 16-23, 1926.* Menasha, Wisc.: George Banta, 1929. Vol. 1, pp. 687-91.

Paper presented Aug. 20, 1926, at Ithaca, N.Y., to the ecology section of the International Congress of Plant Sciences. Cowles reviews the origin and migration of Chicago area vegetation in relation to post-glacial climatic changes; as the climate becomes warmer, the flora migrates northward.

1927 "Ecology and Human Affairs." In *Lectures on Plant Pathology and Physiology in Relation to Man.* Philadelphia, London: W. B. Saunders Co., 1928. Pp. 33-41.

Lecture delivered five times Jan. 31 to Feb. 4, 1927, in Iowa (Iowa City, Des Moines, Ames) and Minnesota (Rochester, Minneapolis), as part of a Mayo Foundation sponsored lecture series on plant pathology and physiology. Cowles describes the practical uses of ecological knowledge for agriculture, forestry, etc.

1927 "Persistence of Prairies." *Ecology*, 9, No. 4 (Oct. 1928), 380-82.

Paper presented Dec. 29, 1927, in Nashville, Tenn., to the Ecological Society of America. In considering reasons why some areas have prairie vegetation and other have forest within the same climatic zone, Cowles suggests that a contributing factor may be a tendency for prairie itself to develop a soil which is especially conducive to the continuation of prairie vegetation.

1929 "John Merle Coulter." *Botanical Gazette*, 87, No. 2 (March 1929), 211-17.

Obituary, with a summary of Coulter's life and work.

1930 "President's Opening Speech to Section." *Fifth International Botanical Congress, Cambridge, 16-23 August, 1930 Report of Proceedings*, ed. by F. T. Brooks and T. F. Chipp. Cambridge, Eng.: University Press, 1931. P. 48.

Abstract of opening words presented Aug. 18, 1930, at Cambridge, Eng., to the Fifth International Botanical Congress, Section E (Phytogeography and Ecology), in Cowles' capacity as section president. He notes the rapid development ecological study has undergone in one generation and the contributions it has made to other fields of theoretical and applied science.

1931 "Conservation of Illinois Areas of Botanical Value." *Transactions of the Illinois State Academy of Science*, 24, No. 2 (Dec. 1931), 86-89.

Speech presented May 8 or 9, 1931, at Peoria, Ill., to the Illinois State Academy of Science. Observing that places of scenic beauty are often also ecologically interesting, Cowles lists botanical features of existing state parks and recommends other sites for designation as parks.

1932 "The Ever-Changing Landscape." *Scientific Monthly*, 34 (May 1932), 457-59.

Radio talk in the series "Science Service Radio Talks Presented over the Columbia Broadcasting System." Cowles offers a survey of plant succession, especially forest succession.

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Cooper, William S. "Henry Chandler Cowles." *Ecology*, 16, No. 3 (July 1935), 281-83. (Part of a special issue of *Ecology* honoring Cowles.)

"Deaths and Funerals. Dr. Henry Chandler Cowles." *Chicago Daily News*, 13 Sept. 1939, p. 30.

"Dr. H. C. Cowles, U. of C. Botany Teacher, Is Dead." *Chicago Daily Tribune*, 13 Sept. 1939, p. 16.

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Cressey, George Babcock. *The Indiana Sand Dunes and Shore Lines of the Lake Michigan Basin.* Chicago: University of Chicago Press, for the Geographic Society of Chicago, 1928.

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Decodon verticillatus (Waterwillow). Mineral Springs, Indiana, 17 July 1913. Glass negative by George Damon Fuller, aep-inn112. image flipped right to left.

Cowles Bog photographed in 1916. This photograph shows the relative scarcity at that time of cattail. Most of the conifers pictured are northern white cedar. No evidence of herbivore grazing is present in this photo. Most of the white cedars today show what appears to be a browse line. Lantern slide in the Department of Special Collections, the University of Chicago Library, aep-ins121.

INDIANA DUNES
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