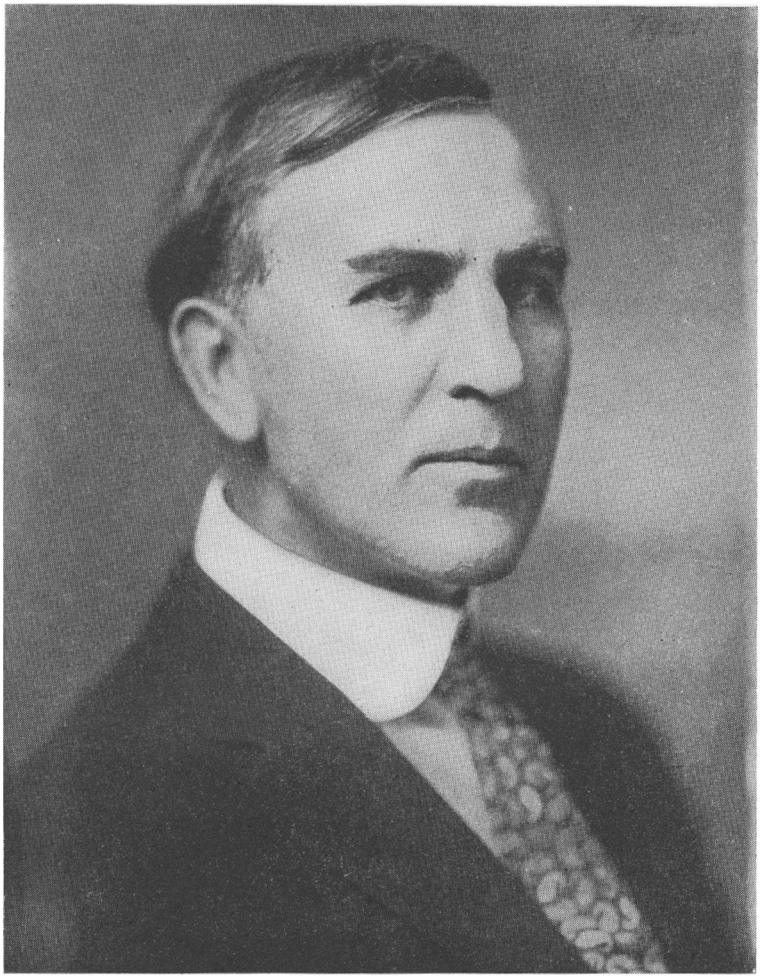

FREDERIC EDWARD CLEMENTS

ECOLOGY

VOL. 26 OCTOBER, 1945 NO. 4

FREDERIC EDWARD CLEMENTS

(1874–1945)

The ecologist is interested primarily in the effect of environment. During his formative years, Clements was subjected to the influence of an unusually active group of botanists. Dr. Charles E. Bessey came to the University of Nebraska in 1884, when Clements was ten years old. About two years later a clique of juniors, sophomores, and freshmen, who resented the academic superiority of the classical and literary groups, planned aggressively the furtherance of field botany at Nebraska. There was no organization, but constant action. By 1891, calling their group the Botanical Seminar, they held an open meeting and took in one new member. At about this time Pound and Clements joined the group. A Flora of Nebraska was planned and partly carried out. It was to "supply a description of every species of plant in the state from the simplest water-slimes to our highest and most complex flowering plants."

Under the inspiration of Bessey and with fraternal enthusiasm Webber, Smith, Woods, Rydberg, Williams, Saunders, Shear, Pound, and Clements travelled widely over the state, collecting plants and studying the vegetation. Any botanical article, without reference to the language, was read, and every plant, whether desmid or forest tree, was interesting. By 1893, when Clements was nineteen, he had collected hundreds of plants and named many new species of fungi. His interests at this time, judging from published papers, included among others histogenesis, structure and nomenclature of lichens, North American hyphomycetes, methods of determining secondary species, and phytogeography.

So general an interest in many phases of botany was naturally synthesized to an ecological approach to the earth cover, and although his attention repeatedly turned to taxonomy, morphology, and physiology, his general approach was to solve the problem of the earth's cover of vegetation. To this work he brought an astonishing amount of knowledge of individual species, and seldom in the field, and he travelled extensively, was he unable to name at sight any plant he found.

He married Edith Schwartz in 1899, who survives him, and who unsparingly devoted her unusual ability as an illustrator, linguist, and botanist to aid her husband in his work.

Born at Lincoln, Nebraska, September 16th, 1874, he died at Santa Barbara, California, on July 26th, 1945. He was actively engaged in research until a few weeks before his death. He received his B.Sc. in 1894, M.A. in 1896, and Ph.D. in 1898 from the University of Nebraska. In 1940 this University conferred an honorary degree of LL.D. upon him in recognition of his contribution to botanical science. He was a member of many scientific organizations at home and abroad and of Sigma Xi and Phi Beta Kappa.

From 1894 to 1907 he was Instructor, Associate Professor of Botany, and Professor of Plant Physiology at the University of Nebraska. He was then appointed Professor of Botany and Head of

the Department at the University of Minnesota, which position he held until 1917, when he was called to the Carnegie Institution of Washington as Research Associate to take charge of Ecological Research. In 1941 he retired from this position but continued his work at the Alpine Laboratory on Pikes Peak, where he spent his summers, and at the Coastal Laboratory at Santa Barbara, where he spent the winter.

He had many co-workers and constant contact with young men, who, as students in many cases, accepted his philosophy and methods and carried them into the applied fields. In 1937 he became a collaborator with the Soil Conservation Service and devoted much time, study, and actual consultation to its problems.

He was essentially a philosopher and although he held tenaciously to field observation and experiment as the only safe guides, his analysis and synthesis of the results was his greatest contribution. It would be difficult in the space allotted to do more than outline the work he has done. "New Species of Fungi" were published in 1893, and in 1897 "A Re-arrangement of the North American Hyphomycetes" with Pound. This was followed by short papers on "Zonation" and "Systems of Nomenclature." "The Phytogeography of Nebraska" with Pound (1898) was a rather pretentious work for that period and brought wide recognition. At about the same time Cowles at Chicago presented his dynamic ecological work on the sand dunes.

Clements published on the "Histogenesis of the Caryophyllales" in 1899 and "Greek and Latin in Botanical Nomenclature" and "Herberia Formationum Coloradensium" in 1902. His life's work was foreshadowed when he published "Development and Structure of Vegetation" in 1904, for this was in a real sense the beginning of his later works. "Research Methods in Ecology" (1905) and "Plant Physiology and Ecology" (1907) were in the nature of textbooks based largely on his own work. "Cryptogamae Formationum Coloradensium" was published in 1908. The period 1907–1916 was devoted largely to the Botanical Department of the University of Minnesota and to "Minnesota Botanical Studies." In addition, there appeared "Genera of Fungi" (1909), "Minnesota Mushrooms" (1910), "The Life History of Lodgepole Burn Forests" (1910), and "Rocky Mountain Flowers" (1913) with Edith Clements. Probably his greatest book, "Plant Succession," was published in 1916.

From 1917 on he devoted his time entirely to research. "Plant Indicators" was published in 1920 and then followed a number of publications in various phases, such as "Aeration and Air Content" (1921), "The Phylogenetic Method in Taxonomy" (1923) with Hall, "Experimental Pollination" (1923) with Long, "Experimental Vegetation" (1924) with Weaver, "The Phytometer Method in Ecology" (1924) with Goldsmith, "Flower Families and Ancestors" (1928) with Edith Clements, "Plant Ecology" (1929) with Weaver, "Plant Competition" (1929) with Weaver and Hanson, "Genera of Fungi" (1931) with Shear, "Bioecology" (1939) with Shelford, and "Adaptation and Origin in the Plant World" (1939) with Martin. Much of his later work along the line of the origin of species was carried on at the Alpine Laboratory (1907–1944) and at the Coastal Laboratory (1925–1945).

He was much interested in climatic cycles and also in the Great Plains. Many articles, such as "Plant Succession and Human Problems" (1935) and "Climatic Cycles and Human Populations on the Great Plains" (1938), indicate the practical application of studies in plant succession. Alone and with his collaborators he contributed freely to the Carnegie Institution publications and to scientific journals.

During the last half century, Clements gave untiring and uninterrupted devo-

tion to the study of vegetation. He based his classification of the earth's cover on the vegetation itself, believing that the vegetation is an indicator not only of the climate but of the past development of the climax as well. Probably the most concise statement of his philosophy and methods of approach is found in "The Nature and Structure of the Climax" (Jour. of Ecology XXIV: 252–284. 1936) and "The Relict Method in Dynamic Ecology" (Jour. of Ecology XXII: 39–68. 1934). Viewing the climax formation as a fully developed organism, the younger and developmental phases were fitted into an elaborate system with a complex terminology. Climax is inseparably connected with climate. It "is not merely a response to a particular climate, but is at the same time the expression and indicator of it." "As an organism, the formation arises, grows, matures and dies. Its response to the habitat is shown in processes and functions and in structures that are the record as well as the result of these functions. Furthermore, each climax formation is able to reproduce itself, repeating with essential fidelity the stages of its development." "The climax formation is the adult organism, of which all the initial and medial stages are but stages of development." "It is the climax community of a succession that terminates in the highest life-form possible in the climate considered."

In this development, there are pauses along the route and these often of long duration. Such a pause at or near the end of a succession is called a proclimax. The one just preceding the climax is a subclimax. Those caused by biological or other disturbances of the normal trend are called disclimaxes. Owing to a tendency to dessication, there are many examples in favorable locations where the vegetation holds its place after the climate becomes too dry for its maintenance over the whole area. These are called postclimaxes or relicts and afforded Clements one of his chief means of interpreting change in vegetation. The recognition of succession and the classification of the stages is a major criterion for studying any plant community. He has given a system of names to climax communities as well as to various successions (seres) which designate the origin and nature of the succession, whether it be from bare rock to climax, or change during a geologic era, or the whole period of vegetational occupancy of the earth.

Whether we agree or disagree with the system, it is so far the only proposed scheme which demands a rather complete understanding of all the successional changes which have brought about the present structure. Even though we fail to accept in full the theory that the climax formation is an organism, the system is none the less useful in helping to explain the inseparable connection of the formation with the climate, and the heterogeneity or diversity of the vegetation. I would agree with A. G. Tansley and say "that Dr. Clements has given us a theory of vegetation which has formed an indispensable foundation for the most fruitful modern work" and that he "is by far the greatest individual creator of the modern science of vegetation."

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