

Southern Arizona  
Guidebook II  
Arizona Geological Society



1959

Reynolds

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# ARIZONA GEOLOGICAL SOCIETY

## SOUTHERN ARIZONA GUIDEBOOK II

*Combined with the  
2nd Annual Arizona Geological Society Digest*

Edited by L. A. Heindl

*Prepared for Field Trips held in connection with*  
Geological Society of America  
Cordilleran Section 55th Annual Meeting

*April 2-6, 1959  
Tucson, Arizona*

## WELCOME TO THE UNIVERSITY OF ARIZONA

The University of Arizona extends greetings and a cordial welcome to the members and guests of the Cordilleran Section of the Geological Society of America in its annual meeting on April 2 to 6, 1959, and to the Pacific Coast Branch of the Paleontological Society and the Seismological Society of America, associated societies meeting on the campus concurrently.

The University is pleased to make its facilities available for these meetings, and invites you to visit its various divisions and to become acquainted with the work being done. The College of Mines is outstanding for its instruction, experimentation, and research in geology and mineralogy and in mining and metallurgical engineering. The College operates in close cooperation with the Arizona Bureau of Mines and the United States Bureau of Mines, both of which have offices on the campus, and with the College of Engineering.

You may wish to visit the University's scientific and other laboratories and the Arizona State Museum, which is located on the campus and contains outstanding collections of materials pertaining to man's habitation of the Southwest from prehistoric times. The Laboratory of Tree Ring Research is located in the west stadium building and the Geochronology Laboratories have their offices on Tumamoc Hill, west of Tucson. The Art Gallery of the Fine Arts Center has many famous works of art, including the Samuel H. Kress Collection.

It is my hope that you will have a most pleasant time and a successful series of meetings and field trips.

Richard A. Harvill  
President

## GREETINGS FROM THE ARIZONA GEOLOGICAL SOCIETY

To all participants of the 55th Annual Meeting of the Cordilleran Section of the Geological Society of America held in Tucson, Arizona, April 2 to 6, 1959, the Arizona Geological Society sends welcome with most cordial greetings and best wishes. Your presence justifies the offer of our full hospitality and the cooperative effort of members of the Arizona Geological Society who contributed generously their time and knowledge to the preparation of the field trips and the Guidebook. We hope you will be rewarded by finding interest in the geology of Arizona and the field trips.

It is our sincere trust that through this meeting and these field trips, we will all gain a better understanding and appreciation of each other, our mutual problems and progress, and thereby benefit society, the profession, and each individual.

Walter E. Heinrichs, Jr.  
President

This Guidebook is  
dedicated to

BERT S. BUTLER  
Professor of Geology  
University of Arizona

Scientist and Teacher, Inspiring and  
Provocative Guide to Others in the  
Geological Profession

## BERT S. BUTLER: TEACHER-SCIENTIST

Truman H. Kuhn  
Dean of the Faculty  
Colorado School of Mines

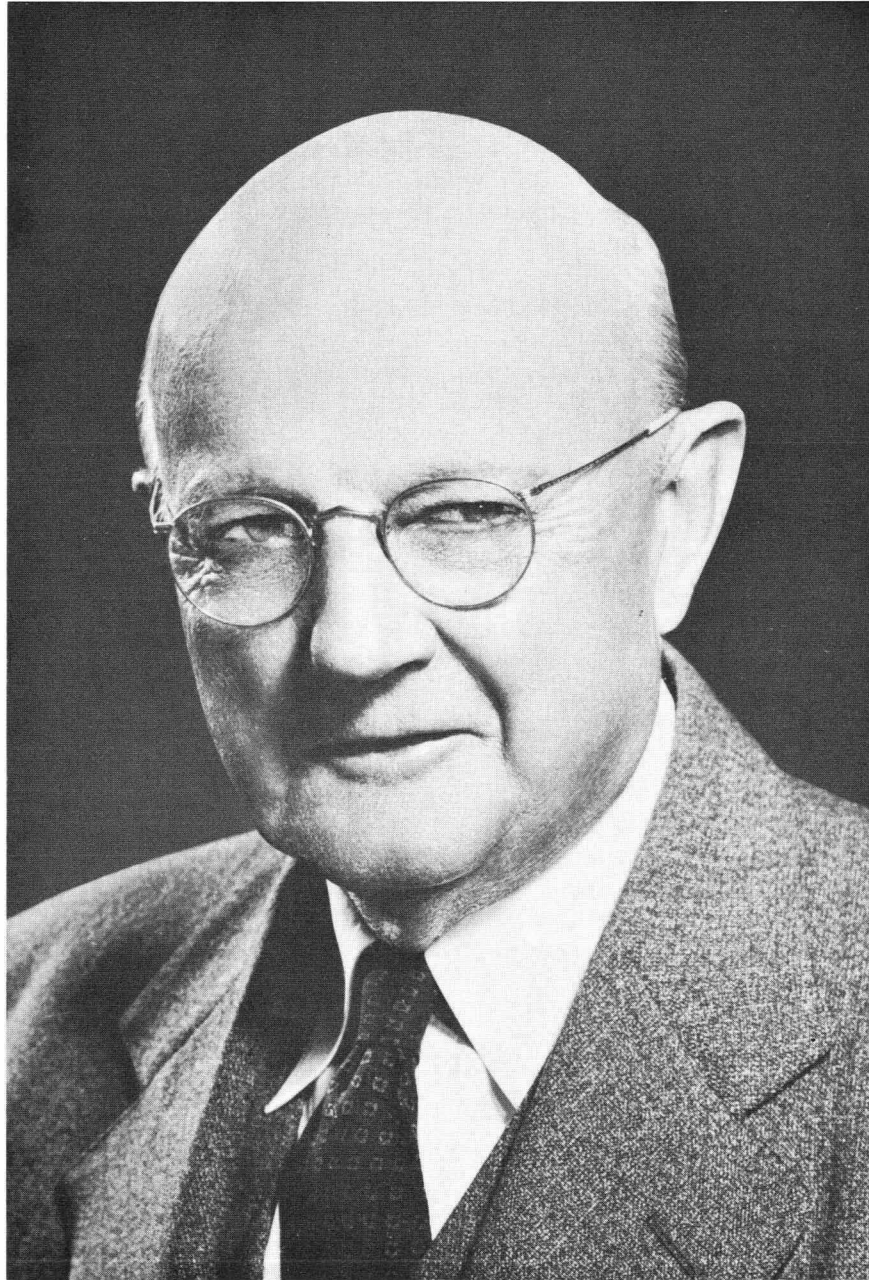
When I was asked to prepare a dedicatory article in recognition of Bert S. Butler, my immediate reactions were varied and apprehensive. First, I considered the task before me a compliment, since there is the implication that I am able to record creditably those scholarly and personal traits of Dr. Butler that have led him to a distinguished career in the geological sciences. Second, I reacted to the underlying idea that to write of Dr. Butler is also a recognition for me, a recognition in the sense that as author I will hereafter be connected with an illustrious name in science. Consequently, in all humility, I alert my colleagues to the central point in this essay: we are concerned not with style, mechanics, or structure, but with B. S. Butler: teacher-scientist.

Over the past half century, the world has been undergoing a series of revolutions -- some silent, others quite voluble -- in government, law, religion, and science. The silent revolution in science is characterized by the subtle tempo of research, discovery, development, and resulting progress. Similarly, in political history, we have been living in an era of constant change, upheaval, and revolution. The course of history in the twentieth century is marked by particular individuals acting as milestones in civilization's movement toward a changed, if not better, existence. Placed in the matrix of their traditional and intellectual topography, many of these political individuals stand out in sharp relief as dramatic catalysts and motivators of progress or destruction.

The scientists, though lacking this essential flair for the dramatic, have in their silent method stockpiled a store of knowledge that can prove destructive or progressive, contingent upon the application of their discoveries. And like the pattern in political history, the course of scientific progress can be plotted by the efforts of particular individuals. To the layman, in general, the dedicated teacher or solitary scientist represents an enigma, for here is a person whose entire philosophy of life is based on the premise that thinking man must distinguish himself with activities that are consistent with his attributes. An acceptance of this premise frequently carries with it the misapprehension that the teacher or scientist has voluntarily been abstracted from society in general and has selected a way that, at best, will reward him with minimum security, little dramatic expression, and minute recognition. Clearly, security, drama, and recognition -- all basic human needs -- mean different things to different people; further, to the teacher-scientist these requirements may be translated in terms that express a philosophy of life based on sacrifice.

Who among us has not consciously felt the security provided by the discovery that knowledge resides in the stillness and in the activity of natural phenomena? Who among us has not felt the flush of pleasure that flows from a particular discovery or from a classroom of students whose silent enthusiasm is later expressed by their accomplishments? Finally, what greater recognition accrues to man than to have it said that by his actions he contributed? Explicit in the career of B. S. Butler is this sense of dedication to the service of his profession for the betterment of civilization.

Bert S. Butler was born in Gainsville, New York on March 30, 1877 and com-



pleted his undergraduate degree at Cornell University in 1905. Subsequently, he remained at Cornell for two years as a member of the geology department while completing his master's degree. Later in his career, in recognition for his ceaseless contributions to the mineral sciences, the Colorado School of Mines, in 1928, conferred on him the honorary degree, Doctor of Science. Terminating his association with Cornell University in 1907, he began a significant period of research activity with the U. S. Geological Survey, an association that lasted until 1920. During his work with the Geological Survey, Dr. Butler gained experience and practice, grew in his field of study, and moved upward through the various levels of responsibility. From 1907 to 1909, he was a junior geologist; from 1909 to 1911, an assistant geologist; and in 1919, he was promoted to geologist, in which capacity he served until 1920. All through this long service with the Geological Survey, Dr. Butler conducted many significant studies of permanent value, among them the highly acclaimed report on ore deposits of Utah.

In 1920, he applied his vast knowledge and experience to the minerals industry in his capacity as geologist for Calumet and Hecla Consolidated Copper Company. Under the direction of L. C. Graton, Dr. Butler made a special study of the Calumet and Hecla mineral holdings. In 1924, at the conclusion of his assignment in industry, he again joined the U. S. Geological Survey and, in collaboration with other geologists, prepared a comprehensive report on copper deposits in Michigan.

A servant to his profession, Dr. Butler then left Michigan for Colorado where, under federal and state support, he directed a thorough study of the ore deposits of the southern Rocky Mountain region and the Colorado Plateau. Not content with an executive role in directing the ore-deposit studies, he gave special personal attention to the Climax molybdenum deposits and other deposits of the Mosquito Range. These exploratory activities have obviously resulted in extensive mineral developments whose economic and strategic impact was felt far beyond the national boundaries.

His affiliation with the University of Arizona began in 1927. Based on an active field experience of twenty years, the knowledge B. S. Butler brought into the classroom proved to be a source of awe, admiration, and inspiration for his colleagues and for the many students who have passed through his stimulating courses. Noteworthy in his career as teacher is the integrity with which he searched, evaluated, and concluded. A seeker of the truth, by example he instilled in his students those principles necessary for the ethical basis of a scientist: an accurate collection of facts; an accurate and timely report of the facts; an awareness of human fallibility. Recognizing his responsibility as a teacher-guide, Dr. Butler embraced a philosophy of teaching that interpreted geology in reference to underlying principles. To him, the cut and dried facts represented only a good beginning; more important were the implications of these facts and their relationships to scientific law.

Almost ten years ago, Dr. Butler, in his memoriam to Professor Waldemar Lindgren, stated that "honors in science usually fall about where honors are due." If I may be permitted to do so, turning this particular statement to the career of Dr. Butler is not difficult. As head of the Department of Geology of the University of Arizona from 1931 to 1948, he began drawing attention to, and recognition for, his contributions in the classroom and in the field. His American Institute of Mining Engineers' activities have been aimed toward a reevaluation of accepted conclusions and a stimulation of progressive thinking in the earth sciences. In 1947, the Society of Economic Geologists singled him out for the highest recognition in his field; the Penrose Medal was conferred on Bert S. Butler "for outstanding contributions to the knowledge of the geology of metallic ore deposits." Further recognition of his



stature is evidenced in his "starred" inclusion in American Men of Science, a mute testimony of the judgment of other American scientists.

Dr. Butler has permanently recorded his name in the rolls of science through these honors; however, another facet of the permanency of his efforts is expressed in his extensive publishing record and in the influence he has brought to bear on his students.

One has but to view the bibliography of Dr. Butler to arrive at some interesting conclusions. First, one sees that a good portion of the North American Continent served as his field laboratory. Second, his publishing record, detailed elsewhere in this Guidebook, is a canon marked by almost a half-century of meaningful contributions. Productive scholarship in our universities is generally viewed as an indication of academic curiosity, contemporaneity, and professional growth. Altogether too often, we encounter the producing scholar limited by a peak-production period, after which he tends to vegetate in the twilight slumbers of academic, contented boredom. Dr. Butler's publication record, however, reveals a pattern of continuity, a pattern that is an insight to his ceaseless curiosity, contemporaneity, and growth.

Without a doubt, Dr. Butler's stature in the profession could endure through the recognition his fellow scientists have accorded him and on the inscribed monument of his research efforts. However, his place in the history of American science is assured through an activity that has a far greater influence than either awards or publications. B. S. Butler was a teacher. His remarkable capacity for warmth and interest in his students was complemented by the inspiration he stimulated among young teachers. His role as teacher-scientist was balanced by a gentlemanly attitude that has endeared him to those of us who enjoyed even the slightest personal relationship with him.

Through the years at the University of Arizona, he touched and stimulated the minds of hundreds of young people who have carried his erudition all over the world. Through his many students, Dr. Butler has an eternal place in science, for, like currents and wave patterns, his influence as a teacher will continue wherever his students go. Perhaps the most singular feature in his entire career is the fact that he never ceased to be a student. At home, in the field, in the seminar room, or in the laboratory, he was a complete man; for he was constantly studying, thinking, and giving.

Dr. Butler married Miss Loretta Bergen on December 24, 1928. Mrs. Butler is keenly appreciated among Dr. Butler's students and associates for her kindly forthrightness and deep interest in their families and careers. In 1957 Dr. and Mrs. Butler established at the University of Arizona a scholarship fund for graduate study in geology. The Bert S. Butler Scholarships will be additional milestones in the progress of science; among the recipients there will be men to carry on a tradition of scholarship founded on the intellectual attitudes of an honorable teacher-scientist.

At the conclusion of this 55th annual meeting of the Cordilleran Section of the Geological Society of America, we will disperse to our various campuses and occupations to continue our work. With us we will take the comfort and pleasure that flow from the knowledge that we were in the presence of the grace, the charm, and the exemplary humility of an outstanding colleague. Bert S. Butler will endure because his accomplishments are eternal marks in the history of American scientific progress and because he was a teacher-scientist endowed with a sincere gentlemanly warmth.

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## NOTE

The time notation used throughout the road logs indicates direction for observation: 12:00 is straight ahead; 9:00 is full left; and 3:00 is full right.

Cross reference between articles in this guidebook is made by listing the name of the author and the underlined Arabic number of the article. For example, a reference to article 4, The Precambrian rocks in southern Arizona by John F. Lance is shown as (Lance, 4). Similarly, field trip road logs are referred to by the number of the field trip in Roman numerals. The road log for the field trip to the chaotic breccias in the Tucson Mountains is referred to as Field Trip IV. The corners of the pages of the sedimentary and igneous rock charts are marked for handy location.