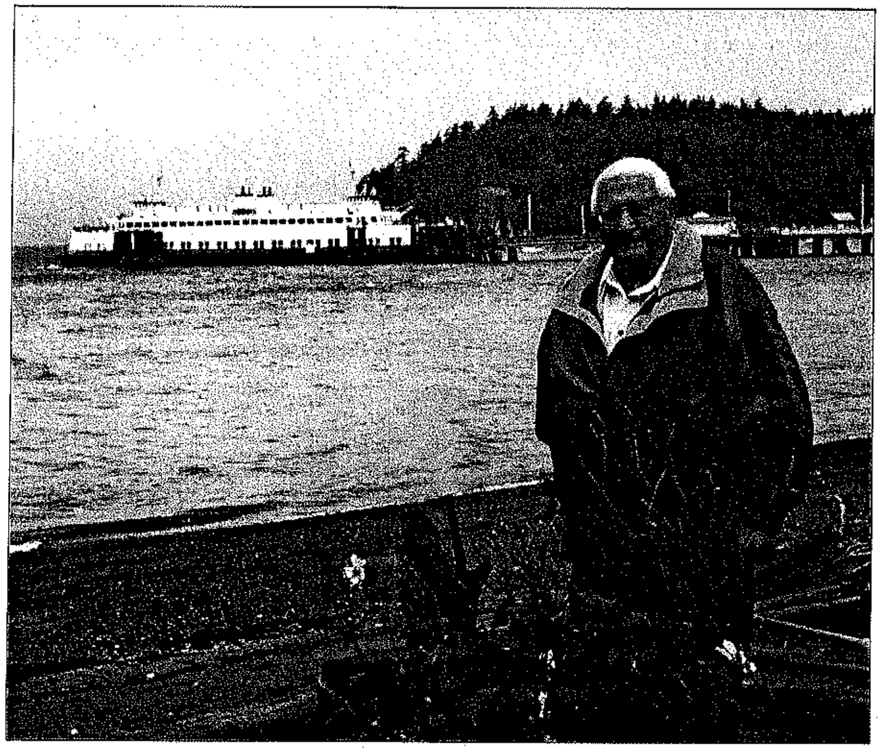
Thor Karlstrom '43



I attended Augustana College, Rock Island, Illinois, between 1940 and 1942 after transferring from the University of Washington in my sophomore year. Father, mother and my four brothers all had or were to attend Augustana. My Father, Otto R. Karlstrom, was a Swedish sailor who had sailed the seven seas in stately sailing ships, began his formal education at age of 21 at the Augustana Academy in 1901. Ten years later he graduated from the Augustana Seminary and became pastor of Bethany Lutheran Church in Seattle, Washington, where I was born in 1920.

Uncertainties about my own career are reflected in changing majors successively in Sociology, Psychology and languages before finally deciding to become a geologist after taking a geology course from Dr. Fritiof Fryxell in the first half of my Junior year. Dr. Fryxell's creative and challenging teaching methods, his emphasis on scientific approaches to remaining controversies in geologic processes including continental drift, climatic change and planetary evolution, turned me on. As briefly noted below, this challenge as an undergraduate launched me into a surprisingly diverse, challenging and adventuresome professional career.

In 1943, I began graduate work in geology at the University of Chicago, first on an Augustana Faculty Scholarship, and later on a Departmental Scholarship. As a Teaching Assistant I taught courses in photogrammetry and photo interpretation to selected soldiers returned from the European Theater for further intelligence training. The acquired skills developed in photo interpretation served me well in later mapping projects both on earth and on the moon. My doctoral thesis, published by the Montana Bureau of Mines and Geology, is titled "A Structural and Economic Geological Analysis of the Abandoned Hecla Mining District in SW Montana" under advisors Drs. R. T. Chamberlain and Robert Balk.

In 1946 I accepted a position at Upsala College, East Orange, New Jersey, where I joined Professor Vernon Swanson, another Fryxell geology major. Our commission was to develop a physical plant and a curriculum for a Department of Geology modeled after that at Augustana. Two years later I chaired a 3-faculty department with a working museum of rocks, minerals and fossils donated to the department by the Military Academy and a curriculum supporting an accredited major in geology.

I accepted a position in 1949 with the Alaska Terrain and Permafrost Section, Military Geology Branch of the U.S. Geological Survey, with offices in Washington, D.C. My Branch Chief was Frank Whitmore, Jr., who had worked with Dr. Fryxell on terrain intelligence in the Philippines. My primary responsibility was to map regions in Alaska and the Arctic for the dual purpose of analysis of geologic factors directly and indirectly affecting military operations and to reconstruct glacial history of the Cook Inlet region, Alaska, using new techniques of dating and correlation by radiocarbon and other radioactive minerals. The resulting reconstruction as correlated with the other dated Pleistocene marine and terrestrial records support the following conclusion: 1) the Pleistocene involved many more than four Ice Ages conventionally assumed for the continental ice-sheet records; - the most detailed sea-core records suggest about 20 major glaciations between circa two million-years and ten-thousand years ago; and 2) the expanded record which was evidently modulated by solar insulation changes resulting from the earth's movements around the sun (The Milkankovitch Climatic Model). I further proposed that the many superimposed secondary glacial changes in the record were also cyclical in nature and probably modulated by tidal force changes generated by Sun/Moon/Earth orbital relations (the Petterson Climatic Model). This paleoclimatic model is described in some detail in my 1961 New York Academy of Science paper. Most Pleistocene geologists now accept the role of solar insulation in modulating Ice Ages; but few researchers have seriously considered the possible role of changing tidal forces in influencing the shorter term climatic changes so evident in high-resolution paleoclimatic records.

I joined with other Geological Survey colleagues (H. Coulter *et. al.*) in compiling a map showing the boundaries of multiple glacial advances in Alaska. A companion map (T. Karlstrom *et. al.*, 1940) at a larger scale shows the distribution of the glacial moraines used in drawing the main ice boundaries, in addition, the associated stream, lake, marsh, wind, mountain and marine surficial deposits throughout Alaska. As principal compiler of the map, I used photointerpretive techniques in mapping the remaining areas in Alaska where inadequate ground observations existed on the surficial deposits.

One of the resulting findings was an ice-free zone on Alaska's Kodiak Island that persisted during the last two or three glacial stages. A multidisciplinary research expedition to the island was organized to check my geologic interpretations and to detect any changes in plants and animals that may have resulted from the long periods of isolation within the refugium. Expedition results are presented in a book published by the Boreal Institute, University of Alberta (T. Karlstrom and G. Ball, Editors, 1969).

After fifteen years of mapping in Alaska and following completion and publication of Surficial Geology Map of Alaska, I shifted my research focus in 1964 by joining the Astrogeology Branch of the Survey. My first Branch Chief was Dr. Eugene Shoemaker, and later Dr. Alfred Chidester, a former fellow student of mine at Augustana. My first assignment was to evaluate the quality of lunar photography taken by the Ranger Mission, and compile a photogeologic map of the Schickard Crater Quadrangle on the near side of the moon. My map differs somewhat from other Lunar Quadrangle maps in 1) mapping the regional pattern of lineaments and faults as possible clues to the character of underlying structures and rocks; and 2) in introducing an upland map unit suggesting that the bright ejecta-covered uplands are probably underlain by volcanic rocks representing a pre-mare vulcanism generated early in lunar history. Compositional data of lunar surface rocks and soils obtained by recent remote-sensing missions to the moon supports the interpretation of such an early molten phase so extensive that it is referred to as *Magma Oceans.*

As Mission Planner for the Branch, I was primarily responsible to do format of the scientific components of data packages carried on early Apollo Missions. The data package of Apollo 11 was designed primarily to support the lunar landing. Those of Apollo 11 were designed primarily to support the lunar landing. Those of Apollo 12 and 13, in addition, included large scale photogeologic maps of designated landing sites to show Survey-recommended routes to be taken by the astronauts in optimizing their scientific observations and sampling at the sites. These maps designed for use on the lunar surface were also used in briefing the astronauts on landing-site geology before the missions.

Apollo 12 carried the first geologic map used for extraterrestrial exploration and was featured on the cover of an issue of Science Magazine. As noted by astronauts Conrad and Bean during their lunar traverse, the traverse map proved highly useful in directing their observations and sampling of the local geologic features. Because of the tragic explosion on Apollo 13, the data package maps were not used on the moon. The Apollo 12 briefing map is displayed in Augustana's Planetarium. I retain the original copy of the Apollo 13 briefing map.

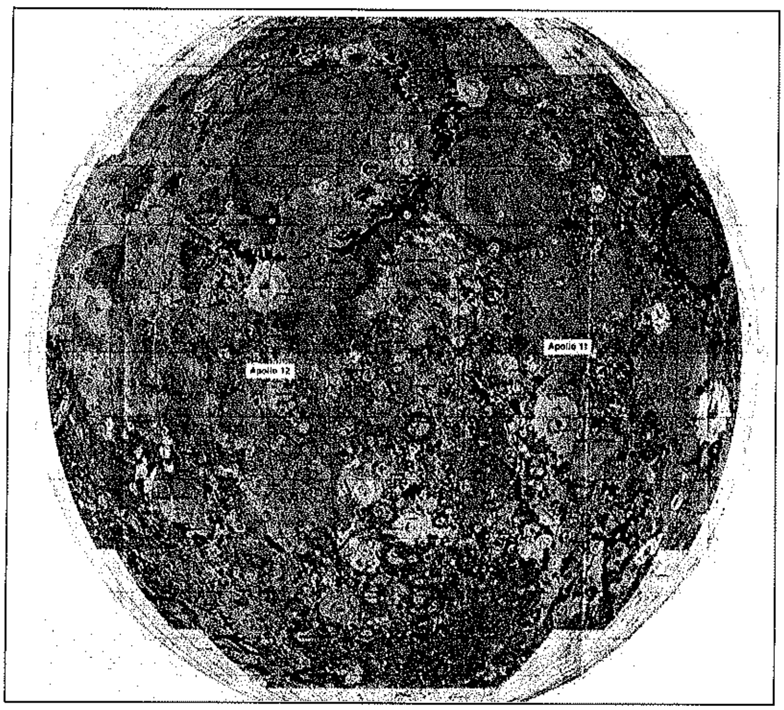


Photo and caption of near side of moon showing landing site locations of Apollo 11 and 12.

My next assignment as Mission Planner was to compile a photogeologic map of the lunar Oriental Crater region and to develop a plan as a preliminary model for a long-stay lunar exploration mission using permanent living quarters and vehicles (rover trains) with capabilities for long distance traverses. This map and accompanying text were transmitted to NASA and their present location is not known. If located, the manuscript might prove useful as a prototype plan for President Bush's recent proposal for colonizing the moon.

While engaged in lunar mapping, I began field observations, sampling and research on the

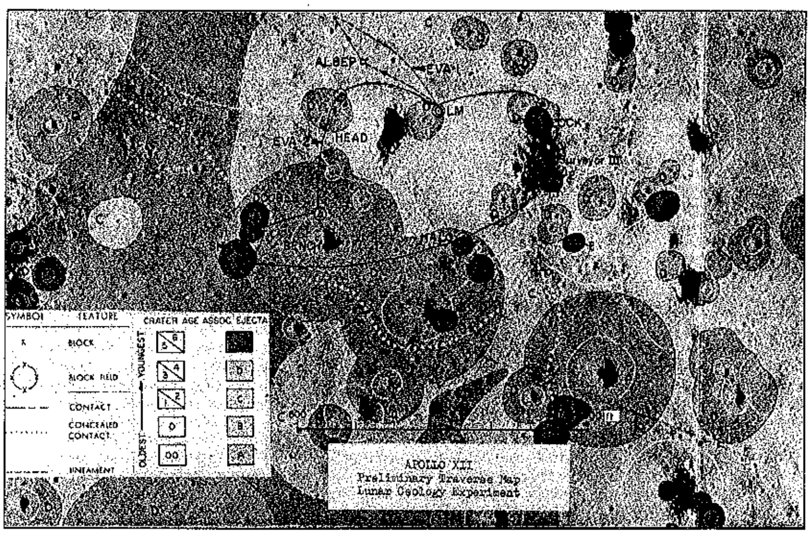
Southwest's alluvial and climatic history. This research was designed to develop a detailed, independently dated chronology of Southwest paleoclimate for comparison with my Cook Inlet, Alaska, chronology and with independently detailed records in other regions of the world.

As geologic consultant to the Black Mesa Archaeological project, I joined two archaeologists, a dendrochronologist and a botanist in search on the cultural history and associated hydrologic, vegetation and tree-ring changes in the region. As a member of this "Gang of Five", I contributed to numerous papers on the cultural, biologic and physical history of the Colorado Plateaus. Our combined multidisciplinary data support previous conclusions that the prehistoric peoples' movements and abandonments on and from plateaus were primarily induced by climate changes. In turn, the recurring droughts were cyclical with alternating periods of stream-aggradation (wet) and arroyo-cutting (dry) phasing with the ca. 275-year cycle first detected in the dated tidal-bog (sea level) record of Cook Inlet. Significantly higher resolution regional tree-ring records provide confirmation of this hydrologic cycle as well as defining its 2/1 resonance of ca. 139-years and with floodplain aggradation dominantly occurring during tree-ring wet intervals and with arroyo cutting and floodplain-terrace formation during tree-ring drought intervals.

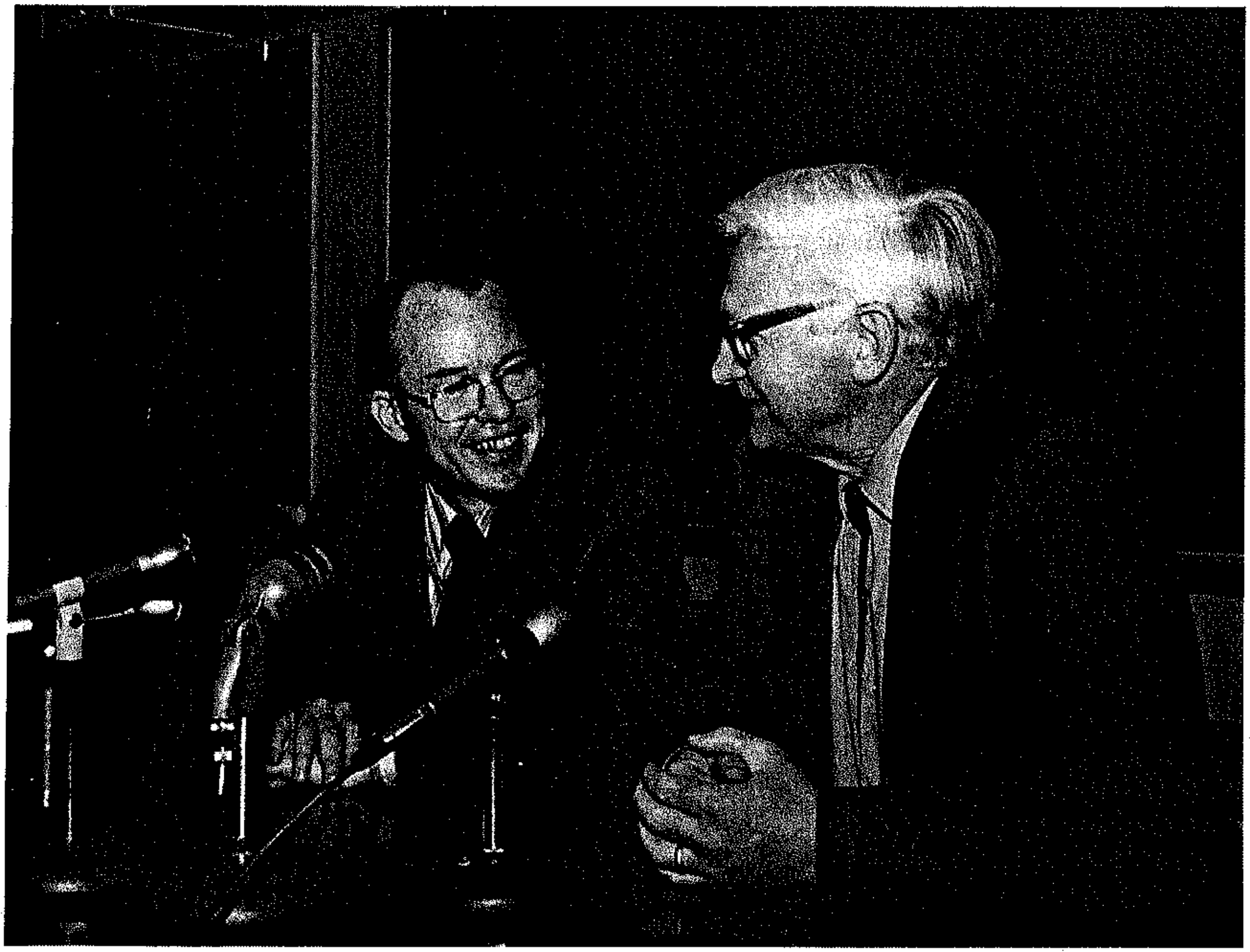
Retiring in 1983, I continued my research in paleoclimate by analyses of the increasing number of published paleoclimatic time series in the international literature. Since 1984, I have contributed many papers to the Transactions of the Pacific Climate Annual Meetings.

Many of these published time series apparently reflect the same cyclical patterns of climate change with some records extending back thousands of years into the Ice Age period of alternating major cold and warm intervals.

I continue to be skeptical of the prevailing interpretation of man-induced global warming because it is based primarily on the short 200-year instrumental temperature record, because of conflicting computer models of climate, and because it evidently ignores the implications of natural fluctuations in the much longer paleoclimatic record. The trends of the instrumental temperature since 1850 A.D. essentially parallels an increasing temperature trend of the ca. 278-years natural cycle. Thus a major question that needs to be answered is how much of the instrumental global



This is the traverse map of Apollo12 prepared by Thor Karlstrom for NASA. It is located in the Planetarium at Augustana College. (Photo John Deere Planetarium/Carl Gamble Observatory, Augustana College)



Dr. Roald Fryxell and Dr. Thor Karlstrom attend the Seminar on Space Exploration at Augustana College to discuss the "Evidence of Climatic Change and its Causes".

temperature record is the result of natural causes and how much to man's post Industrial Revolution pollution of the atmosphere? At the age of 84, I look forward to continuing my research on the paleoclimate and the unresolved politically tinged problem of global warming.

Looking back into the past, I welcome the opportunity to gratefully acknowledge my debt to Augustana College for providing a balanced liberal arts education and particularly to the late Dr. Fritiof Fryxell for his important and continued contribution to my life and profession.