

50th Anniversary

The Institute of Arctic
and Alpine Research

1951–2001

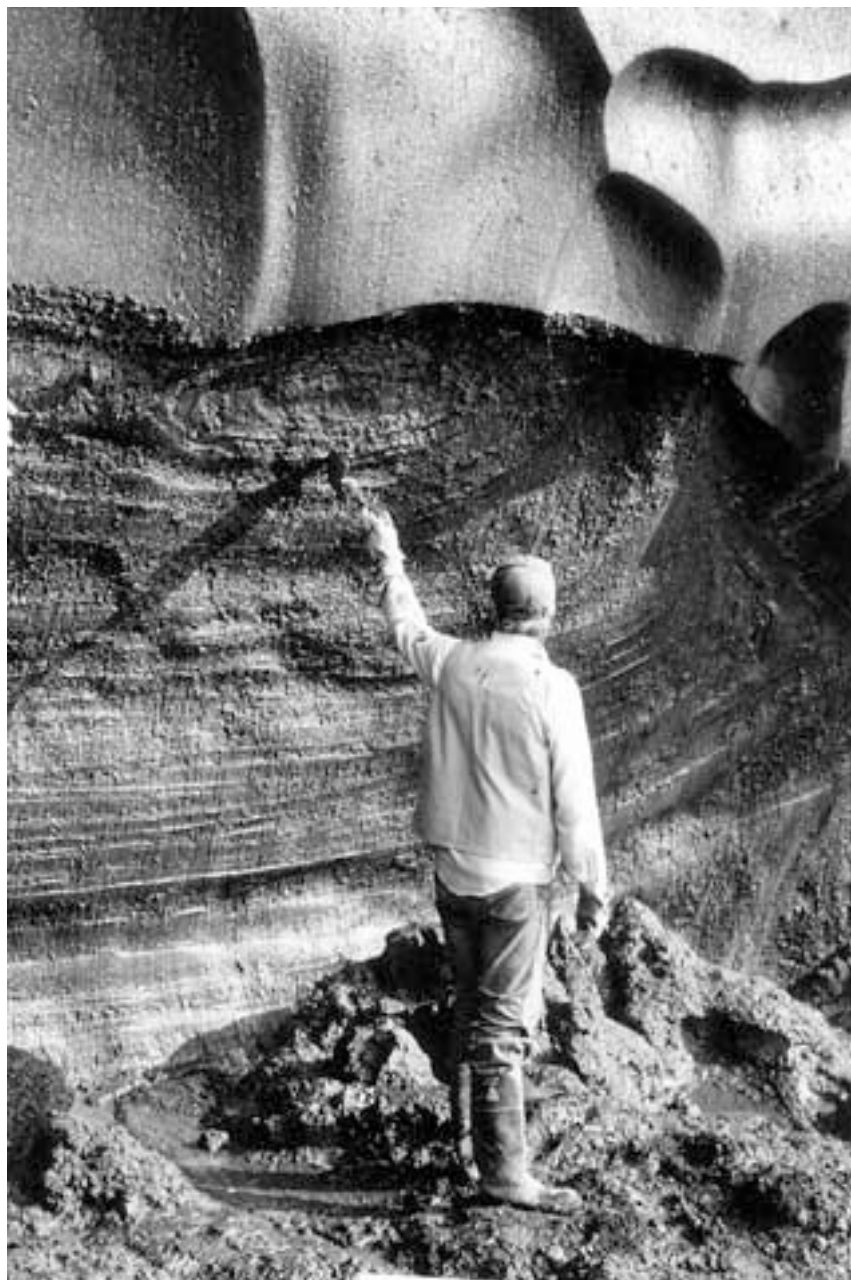


University of Colorado at Boulder

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Scott Elias, INSTAAR, examines massive ground ice, Denali National Park, Alaska. Photo by S. K. Short.

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Contents

- 1 History of INSTAAR
- 29 Memories & Vignettes
 - INSTAAR Photographs*
- 57 INSTAAR's News
- 81 Fifty Years of INSTAAR Theses

credits

Many past and present INSTAAR members contributed to this book with history, news, memories and vignettes, and information. Martha Andrews compiled the thesis list. The book was collated, edited, and prepared for publication by Kathleen Salzberg and Nan Elias (INSTAAR), and Polly Christensen (CU Publications and Creative Services).

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History of INSTAAR

1951–2001

THIS HISTORY OF INSTAAR has been compiled by Albert W. Johnson, Markley W. Paddock, William H. Rickard, William S. Osburn, and Mrs. Ruby Marr, as well as excerpts from the late John W. Marr's writing, for the period during which John W. Marr was director (1951–1967); by Jack D. Ives, former director, for 1967–1979; Patrick J. Webber, former director, for 1979–1986; Mark F. Meier, former director, for 1986–1994; and James P. M. Syvitski, present director, for 1995–2001.

JOHN W. MARR, a young plant ecologist in the Department of Biology of the University of Colorado, realized that to understand the ecology of the neighboring mountains better, it would be helpful to know what processes were going on year round, especially during the winter. There were very few data available for this season at high altitudes. In 1946, he developed a course in "Winter Research in Mountain Plant Ecology," using the facilities at the University of Colorado field station, Science Lodge, for one weekend in each month. On one occasion, he and his students left the Lodge to climb above timberline and stopped for lunch and discussion in the tree-limit area. A blizzard soon enveloped them, and it was agreed that it would be very valuable to have a series of environment measurement stations in the research area. This germ of an idea gradually grew and matured until 20 April 1951, when the Board of Regents of the University of Colorado established the Institute of Arctic and Alpine Ecology (IAEE) to more effectively nurture the study

of arctic and alpine regions. Dr. Marr was appointed director by the president of the university, Robert L. Stearns. Within two years IAEE became the Institute of Arctic and Alpine Research (IAAR).

1951–1953: The Early Years

The ideas that led to the beginning of the Institute were those of John Marr; he was educated in the philosophy that dominated plant ecology during the first several decades of the 20th century. Following Tansley (1935), his work was based on the concept of "ecosystem." In a speech to the Rocky Mountain Alpine Seminar, 7 December 1956, Marr articulated his philosophy thus: "... it is much better to do our work and thinking in terms of ecosystem units than to attempt to work with communities and environment as discrete entities. The community is, of course, in any area, a very artificial unit in that it does not have any integrity when separated from its environment." Further, in an address at the Denver Botanic Gardens at the XI International Botanical Congress Field Excursions, 31 July 1969, he describes what he means by ecosystem: "... an ecosystem is the smallest complete functional unit in the landscape. . . . It consists of organisms, environmental factors, and ecological processes operating in a dynamic open-ended system."

The prevailing point of view was that equilibrium exists between major groupings of plants (communities) and their regional climates. Thus, grasslands, deciduous forests, coniferous forests and deserts, for example, are characterized not only by different plants, but by different climates. These equilibrium

communities were referred to as climatic climax communities, and they occur on sites that are considered to be “normal” for the climatic type. The boundaries between them according to this view are climatically determined.

Other communities occur that are in equilibrium with local conditions that override the regional climate, for example, steep slopes, wet depressions, fire, unusual soil conditions and the like. For these situations, Marr introduced the concept of topo-edaphic climax, which was commensurate with Tansley’s ideas of polyclimax.

John Marr emphasized the concept of ecosystem and illustrated the ecosystem by reference to the altitudinal distribution of climate regions in the Front Range of the Rocky Mountains west of Boulder. Nowhere was the point about primacy of the climate made more clearly to Marr’s students than in his year-long course “Winter Research in Mountain Plant Ecology,” where he argued that one cannot fully understand the dynamics of ecological units unless one knows winter conditions, the traditional “off-season” for most ecologists.

John Marr’s interest in climate coincided with national defense needs. The U.S. Army’s Quartermaster Research and Development Command found that to equip troops for potential action in a variety of world climates, it needed to know more about the weather in which they would be operating. Mountain climates were among the areas of their interest. In due course, Marr proposed to the Quartermaster Corps that they enter into a contract with the University of Colorado to study climates in the Colorado Front Range. Negotiations for the research project were concluded in 1951, and with the agreement of the University, Science Lodge, the University’s abandoned summer science camp, became the base of the Institute’s field operations. (For much more information about Science Lodge—The Mountain Research Station—and its history refer to: Kindig,

Jean Matthews, 2000. *The Mountain Research Station: A Research Station with an Altitude*. The University of Colorado Institute of Arctic and Alpine Research. 61 pp.)

John Marr assembled a team of graduate students who for several years, served as the backbone of field operations. These students were Albert W. Johnson, William S. Osburn, and William H. Rickard, Department of Biology, and Ronald Headland, Department of Geography. Johnson and Osburn worked throughout the period of the Mountain Environments Project; Rickard left in 1953 for graduate school at Washington State College, Pullman. Headland left the project in 1952. Victor Favier and Markley Paddock worked on the project during these years as did many other field assistants, among them Harold Mooney, Ricardo Luti, and O. Albert Knorr.

Planning began on two major fronts: (1) locating sites and installing 16 climatic stations within the four major climax regions of the Front Range from 7,500 to 12,300 feet altitude; and (2) renovating Science Lodge for use as a year-round base.

Field exploration soon confirmed that a more or less continuous ridge system extended from the westernmost extent of Niwot Ridge at about 12,500 feet altitude eastward to about 7,000 feet altitude. Science Lodge, renamed “The Mountain Research Station” in 1967, lay at 9,500 feet elevation on the southern flank of this ridge system. Ecosystems representing the four major climax regions of the Front Range occurred along the ridge system and, except for the highest altitudes were accessible by road. In the study, these four climax regions were referred to as lower montane from about 6,000 to 7,500 ft. alt.; upper montane from 7,500 to about 9,000 ft. alt.; subalpine from about 9,000 to 11,400 ft. alt.; and tundra, above about 11,400 ft. alt. Each of the four was characterized by dominant species: lower montane, ponderosa pine; upper montane, Douglas-fir; subalpine, Engelmann

spruce and subalpine fir; and tundra, low shrubs, grasses and sedges especially the sedge *Kobresia*.

To quantitatively characterize the climates within each of the four climax regions, four weather stations were established in each, thus sixteen stations in all, the major one on a ridgetop and secondary ones on north- and south-facing slopes and valley bottoms at the same altitude as the ridgetop station. Each station was equipped with a standard Stevenson screen instrument shelter, a clock-driven thermograph and hygrograph, maximum and minimum thermometers, a sling psychrometer, standard rain gauge, recording anemometer, and maximum and minimum thermometers installed at 6- and 12-inch soil depths. Observations were to be made weekly.

By September 1951, all 16 stations had been sited and equipped, and observations began. In addition to the weather station equipment, the Army provided vehicles, including over snow "weasels," trucks, and army-issue cold weather clothing. It was the intent of the Quartermaster Corps that the cold weather clothing be worn and tested by the investigators. The testing aspect of this goal proved to be impractical and was not part of the program after the first months.

Parts of Science Lodge were extensively renovated during the summer of 1951 to make winter residence possible. The weekly schedule of observations during the winter months called for leaving the Boulder campus and servicing the lower elevation stations on Thursday, arriving at Science Lodge by late afternoon, spending the night, and servicing the tundra stations on Friday. During the summers, the investigators lived at Science Lodge, and all work was done from there. A weekly summary of collected data became a regular feature of the project from its outset.

To the extent possible, the instrument shelters were installed with the understanding that severe winter conditions, especially

cold, snow, and high winds at high altitudes were to be expected. The shelters were modified with special bracing and guying to hold them in place against winds that at times were in excess of 100 mph in the alpine. Many problems characterized the first year of operation. Most crucial was the inability of standard design weather instruments to function in high-altitude conditions. Much time was spent in designing ways around the problems, because the kinds of instruments that would have served project purposes simply did not exist. For example, clock-driven instruments sometimes stopped because (1) they had a tendency to fill with wind-driven snow; and (2) the lubricants used in the clocks were too viscous for very cold temperatures. To mitigate these problems, instrument cases were sealed against blowing snow and clocks were cleaned often and specially lubricated by expert clockmakers. To provide some respite and protection against severe weather, a small prefabricated, steel hut (the "D-1 Lab") was erected near the tundra station in late summer 1952.

Except for John Marr, who had done research in the Canadian Arctic and had served in Greenland during World War II, none of his students had any experience working in the kinds of weather conditions encountered at high altitudes. Despite this, no serious accidents or mishaps occurred. Marr was extremely careful in field operations, and by direction and example, he insisted that we follow his lead.

In 1966, John Marr announced that he thought that the time had come for the Institute to have a full-time director. He had been balancing teaching, research, and Institute responsibilities for 16 years (his appointment had been half-time director and half-time biology faculty), and he now wanted time to publish material gathered by the environmental measurement program since 1952, to concentrate on his treeline

50th Anniversary: The Institute of Arctic and Alpine Research, 1951–2001

3b

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By the beginning of the summer of 1952, most of the early problems with the climatic data collection had been resolved, and the goal was to obtain a complete set of records for each of the 16 stations for 12 continuous months. Achieving a complete record from all 16 stations was difficult, requiring enormous dedication, long, tiring days, and strenuous, sometimes dangerous, physical effort. The sense of “mission” in that early period of Institute’s existence was no doubt fostered by close collaboration and close working and living conditions. The rustic simplicity of Science Lodge and its setting in the rugged mountains that were being studied helped create and maintain a friendly cooperative spirit and a sense of “family” that has lasted until today.

The Army contract ended in 1954, but collection of climatic data at the four ridgetop stations continued, often on a voluntary basis by Johnson and Osburn aided by volunteers from the community. The winter trips to the tundra station (d-1) required a crew of several people, primarily for safety’s sake. Generally, however, these were the “lean” years for the Institute, and were it not for these voluntary efforts, it might have failed.

1956–1965: Support from The Atomic Energy Commission

The U.S. Atomic Energy Commission (AEC) (now the Department of Energy) needed data to more fully develop their program to be able to predict the fate and effect of ionizing radiation within the environmental regions of the world. The Institute was well located and qualified to answer AEC’s need and since it was within the Institute’s goals in environmental research a proposal was submitted to AEC, and a contract was negotiated in early 1956. In this proposal Marr included comprehensively, for the first time, the purpose and goals of the Institute and how they might be achieved. The ultimate objective was research in arctic and alpine regions by (1) training graduate students; (2) cooperating with and encouraging investigators interested in arctic and alpine research; and (3) developing and carrying out research in arctic and alpine regions.

The essential thrust of the project was basic research in the mountain environments of the Front Range, and, at least initially, the continua-

tion and improvement of macroenvironmental measurement at the four “climatic climax” regions west of Boulder. Of the original Institute staff, only Marr and Osburn remained at the Institute as the AEC contract began. The University provided funds for increased maintenance of Science Lodge and some buildings were renovated. Vehicles, including over-snow vehicles, were found mostly in government surplus. The University traded land with the U.S. Forest Service and increased its holdings in the vicinity of Science Lodge to 190 acres, thereby facilitating better road travel to Niwot Ridge. The new project required more staff, and Ralph “Skip” Greene and John Clark were hired; Greene as a “jack-of-all-trades” at maintenance, over-snow driving, and virtually anything making facilities and equipment functional. Clark was deeply involved in the climate program, eventually becoming the Institute’s “Climatologist.” Greene remained as Science Lodge manager until 1970, and Clark was on the staff until 1980. Mark Paddock rejoined the Institute in summer 1957 and served as “Chief of Operations” until leaving in 1965.

After four years of contractual support, AEC insisted that the project become more “mission oriented.” IAAR’s response was to name Bill Osburn (who had received his Ph.D. degree in 1958) Associate Director and Principal Investigator of the AEC program. He asked Ronald Foreman to be his assistant. Although the four macroenvironmental stations were to be continued, research emphasis was to determine the mechanisms whereby nuclear fallout entered and left the Boulder City Watershed, its pattern of deposition in the ecosystems of the watershed, and to explain the major processes involved in differential distribution and to predict future changes. This research was entitled “Patterns and Processes of Nuclear Fallout in the Boulder City Watershed.”

This program would test progress towards the Institute’s goals of learning the ecology of our alpine segment so that predictions regarding its future could be made given a particular set of circumstances, in this case radioactive fallout. By tracing fallout (via its level of radioactivity) into and between different ecosystems, the processes responsible for differential movement could be identified

50th Anniversary: The Institute of Arctic and Alpine Research, 1951–2001

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and quantified. By balancing the amount of fallout calculated to enter the watershed against the sum of that measured in its ecological components, the degree of agreement would indicate whether sufficient ecological understanding had been achieved, or would additional studies need to be carried out before reliable predictions could be made. To take advantage of the opportunity fallout provided as a tracer, however, it was necessary to overcome the possible limitations inherent in radioactive decay (of fallout). Many sampling activities needed to be accomplished as nearly simultaneously as possible which often led to the coordination of up to 50 participants. Dr. Ronald Foreman organized these efforts while Dr. Horace Quick, Dr. Michael McKenna, Mr. David Jessup, Mr. James Snow, Dr. Estella Leopold, Dr. Eilif Dahl, Mr. Roger Egeberg, and Dr. David Murray were especially helpful in various aspects of the program.

An interesting aspect of IAAR's research in the early 1960s was the discovery that populations of native plants growing in habitats with highly elevated levels of "naturally" radioactive soils were morphologically more variable than those growing in soil with lower levels of radiation (Osburn, W.S., 1961: *Science*, 134[3475]). Further studies by Drs. Lee and Rae Mericle (assisted by Ken Weaver) demonstrated significant interactions of these low levels of radiation with various combinations of light, temperature, and soil moisture, leading to a well supported urging that the biological role of background radiation be reassessed.

1959–1967: Early Diversification in the Research Mission

By the late 1950s, the Institute had received grants from NSF to develop and carry out programs in research participation for college and high school teachers, undergraduate students and outstanding high school students. The participants worked with visiting investigators, graduate students doing thesis research, and on Institute projects. A 1959 NSF grant improved the road system from the Rainbow Lakes Road to the Lodge and from there to Niwot Ridge, a distance of 3.5 miles. An Army surplus van was driven to timberline and parked there to serve a shelter and storage for researchers, while the truck under the van was returned to camp and used as a snowplow for the entrance road.

Beginning in the 1950s other researchers found the support facilities of Science Lodge and the surrounding environment conducive to their own research. Examples of this affiliated research are Peter Martinelli's alpine snowfield studies, Arturo Corte's cryoplanation work near Lake Albion, Peter Wardle's studies on the timberline ecotone, and Bettie Willard's research on the impacts of park visitors on the tundra along Trail Ridge Road in Rocky Mountain National Park. The success of the Institute in attracting grant, facilities, and contract funds encouraged the University to invest in modernizing and improving Science Lodge, and this too attracted increasing numbers of visiting investigators. Some of them include Eilif Dahl, Norwegian alpine plant ecologist; Carl Troll, German geocologist; Robert Crocker, plant ecologist from Australia; Aino Henssen, Swedish lichenologist; Dwight Billings; Rexford Daubenmire and Royal Shanks, American plant ecologists; Eric Hultén, Swedish botanist; Alex Watt, British plant ecologist; and William Mullenders, Belgian palynologist.

In 1961 John Marr published the results of his research on the biota and climate of the Institute's research region from Boulder west to the continental divide as *Ecosystems of the East Slope of the Front Range in Colorado*, in the University of Colorado Studies series, including his classification of the Front Range into ecological zones. The next year, 1962, saw the completion of the modern Alpine Laboratory (now the John W. Marr Alpine Laboratory) at Science Lodge. The University and NSF shared the costs of construction. The laboratory was formally dedicated on 21 June 1963; distinguished Canadian ecologist Pierre Dansereau gave a dedication address, "The Barefoot Scientist" stressing the roles of field stations in biological and other field sciences as a part of a conference on "The Role of Field Stations in Modern Taxonomy and Ecology."

During these years (1956–1966), the radioecology program maintained a vigorous and productive history, publishing 10 contributions, which in total demonstrate the ability and value of INSTAAR's research. This accomplishment was recognized following the final contract report (1966) and earned the principal investigator the first exemplary environmental research award given by the Atomic Energy Commission.

ecotone research and to teach with fewer constraints. A new director was appointed by the University in 1967 bringing to a close this initial period of INSTAAR history. Those of us who participated in the challenges and accomplishments of those early years will always retain the sense of excitement and satisfaction from which we benefitted in our later careers.

1967–1979: Instant Institute

For the first 16 years of its existence the Institute functioned on the strength of a single faculty position (that of the founder and first director, John W. Marr). A new Graduate School Dean, Dr. James Archer, appointed in the mid-1960s, as part of a drive to create a strong research institutional base on campus, set about building an enlarged institute. Jack D. Ives, the Director of the Canadian Federal Geographical Branch, Department of Energy, Mines, and Resources, and leader of a significant research program in the eastern Canadian Arctic, was offered the position. His reluctance to leave Canada became a serendipitous bargaining position which produced six new faculty positions, a commitment to support a quarterly research journal, with a permanent position for managing editor, a geomorphology laboratory and full-time technician (Rolf Kihl from the Geographical Branch), two additional secretarial positions, and new space for headquarters on the Boulder campus. The negotiation brought together a youthful group of colleagues, most of whom had worked together in Canada (John Andrews, Roger Barry, and, subsequently, Pat Webber) or, as in the case of Nel Caine (Australian National University) and Kathleen Blackie (Salzberg) (Edinburgh University), had been on the point of joining them. Dean Archer proposed the phrase “instant institute”; this group in turn, introduced the acronym INSTAAR.

This was a radical turning point in the life of the Institute. The British Commonwealth contingent brought with it strong advantages, together with some initial disadvantages. We attracted numerous Canadian and British graduate students, several of whom are now internationally recognized scholars (Ray Bradley, John England, Alayne Street-Perrott, Jill (Williams) Jaeger, Ellsworth LeDrew, Art Dyke, Colin Thorn, Andy Millington, and later, Bob Crane. Nevertheless, the challenge of integrating a group of foreigners into an American faculty and student body took time. In addition, this group had no track record nor experience with U.S. funding agencies.

The Institute had a fine tradition and the beginnings of a sound infrastructure, yet it had entered a period of quiescence and had virtually no research funding. Thus the first two or three years were ones of entrepreneurship and challenge, which certainly provided stimulation for many new approaches. John Andrews assumed full responsibility of what had originated as the Canadian Geographical Branch's Eastern Arctic (Baffin Island) program, and thus provided the Arctic (paleoclimatic/Quaternary) essence of the Institute of Arctic and Alpine Research; Roger Barry undertook the initial and onerous task of quantitative analysis of the impressive accumulation of climatic data from the mountain stations that John Marr had established and maintained over a period of 16 years, through the dedication of climate observer, John Clark, and logistical support by Skip Greene; Patrick Webber provided tundra ecology credibility; and Nel Caine initiated a remarkable data base for studies in alpine process geomorphology, using the Mountain Research Station and the City of Boulder Watershed as a unique research facility.

This released Ives to approach the hard-knocks politics of extracting funding from the newly-established U.S. International Biological Programme (IBP) Tundra Biome, and as a

result the Niwot Ridge site became the national center for alpine tundra research. The Institute was also able, literally, to muscle in on a U.S. Department of Interior Bureau of Reclamation—Colorado State University axis that provided it with 50 percent of the \$1 million contract that was in the final planning stages for research in the San Juan Mountains on the “ecological impact of winter cloud-seeding.” At the beginning, this was a shot-gun marriage with CSU that, to the credit of all the original contestants, evolved into a highly successful collaboration, which ultimately also involved collaboration with Fort Lewis College in Durango. Furthermore, this research initiative led to a large avalanche research contract, also obtained following intense scientific competition, but assured by our ability to attract the consultative support of Ed LaChapelle (University of Washington), and Malcolm Mellor and Wilfred Weeks (U.S. Army Cold Regions Research and Engineering Labs, Hanover, NH), who collectively represented most of the available national avalanche research expertise. The old mining town of Silverton, in the heart of the San Juan Mountains, became an INSTAAR “home-from-home” year round for more than seven years. The success of the avalanche research program, rated as one of the world’s best at that time, depended on the outstanding efforts of Richard and Betsy Armstrong.

Also during this initial period, the promised new campus accommodation, with laboratories, was realized on the university East Campus on 30th Street, the Mountain Research Station was rehabilitated, and the first issue of *Arctic and Alpine Research* was published within little more than a year (January 1969), under the editorship of Jack Ives and Kathleen Salzberg. One critical component of these early successes was the effective incorporation of three modest NSF-funded “research participation” projects into graduate student and faculty field research. Based at the Mountain Research Station, these

projects provided research participation for high-ability high school students, university undergraduates, and junior college teachers. These Colorado Rocky Mountain summer programs, administered by the director, not only enriched the initially under-funded field research with highly motivated and able young people at little or no expense, but helped, through word-of-mouth and performance of the students, to spread the name of the Institute widely across North America. The program produced some remarkable young scholars and, as one example, the junior college teacher program led James Johnson, of Mesa College in Grand Junction, to obtain his doctorate and to complete a fine career as dean and vice-principal of his college.

Thus, over the first two or three years of the 1967–1979 period, it became apparent that Dean Archer’s phrase “instant institute” developed some real meaning. INSTAAR had acquired an outstanding Arctic Program for the first time, so justifying its name. Under the direction of John Andrews a series of annual field expeditions to Baffin Island were undertaken that continued for several decades and produced an enormous outpouring of publications. Also important were the annual Baffin Island, or Arctic, Workshops, initially held in the 30th Street headquarters and which brought to Boulder Arctic scholars from across North America and northwestern Europe. The principal participants of the Arctic program have accumulated many international accolades; for example, John Andrews has received the Kirk Bryan Medal of the Geological Society of America, a D.Sc. from the University of Nottingham, and membership of the Norwegian Academy of Sciences.

National recognition for Niwot Ridge as a major site for Tundra Biome (IBP) research, led, a decade later, into Long-Term Ecology Research (LTER) designation. The World Data Center A for Glaciology was

transferred to INSTAAR from the U.S. Geological Survey in Tacoma, Washington, in 1976 and, under Roger Barry's direction, continues today, through the National Snow and Ice Data Center in CIRES, as an internationally recognized center for data management and research on the cryosphere. Under the efficient managing editorship of Kathleen Salzbeg, *Arctic and Alpine Research* rapidly achieved international standing. Two members of INSTAAR won John Simon Guggenheim Memorial Fellowships (Ives for 1976–77; Barry for 1982–83). In 1972, Jack Ives succeeded Professor Carl Troll as Chair of the International Geographical Union's (IGU) Commission on Mountain Geocology and in 1973 became chair of UNESCO's International Working Group for Man and the Biosphere (MAB)—Project 6—study of the impact of human activities on mountain ecosystems. These two positions led in 1978 to the establishment of the United Nations University (UNU)'s mountain program, that subsequently became the spearhead for worldwide recognition of mountain problems through AGENDA 21 during the Earth Summit (UNCED) in Rio de Janeiro in 1992, and the UN's designation of 2002 as the International Year of the Mountains. This UNU link brought to the Mountain Research Station in 1979 a series of UNU post-doctoral fellows from Nepal, Thailand, and China, and subsequently from Japan, Bhutan, and Russia. Most notable amongst several highly successful individuals was Dr. Sun Honglei, who, shortly following his return to China, became vice-president of the Chinese Academy of Sciences and senior scientific advisor to Mr. Deng Xiaoping.

1970–1976: Budgetary Stress

From the late 1960s, however, some substantive concerns were much debated. First was the hypothetical status of a research institute within a State with a relatively small tax base

and with a rather money-conscious legislature. This prompted us to try to balance what could be perceived as esoteric research that served little more than to satisfy our intellectual curiosity (global warming was then unthinkable!) and “useful” research that would appeal to State of Colorado legislators in times of budgetary stress. We were able to ensure funding for avalanche and natural hazards research within the territory of Colorado. INSTAAR was also able to assist with the definition of the boundaries of the Indian Peaks Wilderness Area and to work in close collaboration with then Congressman Tim Wirth, which led to President Jimmy Carter designating Niwot Ridge as a UNESCO Biosphere Reserve in 1979. These contributions applied to research within the State of Colorado also produced a meritorious citation signed by the Governor.

Another concern was the financial stability of the Mountain Research Station itself. Some CU administrators had considered the station to be a liability and had recommended its sale. The Institute members were strongly opposed to this view because they regarded it as INSTAAR's prime *raison d'être*. However, it was necessary to overhaul its mode of operation and financial base. A major constraint was the CU administration's insistence that for “overhead” calculations, as part of research proposal budgets, it be classed as “on-campus.” This meant that there was no means of adding station operation costs to proposal budgets while the direct CU budgetary provision was totally inadequate. After a long struggle INSTAAR was able to convince the University administration that “off-campus” designation was justifiable. A program of winterization and construction of new year-round, quality accommodation (much on a volunteer basis on the part of graduate students and faculty) was initiated, and a modern, year-round duplex was built, the Megaron (meeting building) was in large part rebuilt, cabins

renovated, and modern sewerage and telephone links installed. With the increase in research funding, where this related to fieldwork in the Colorado Rocky Mountains, it became possible to provide graduate research assistants (GRAs) with year-round accommodation at the station, and also to obtain rent. Finally, a new position for resident station director was established. The first three incumbents were Professor Michael Grant (Biology), Professor David Greenland (Geography), and Dr. Misha Plam (Glaciology, former director of the Mt. Elbruz Field Station, Institute of Geography, Academy of Sciences, Moscow, and a refugee from the Soviet Union in 1976–77).

Collectively, these measures ensured that the MRS budget was not only balanced, but a significant surplus was created that itself became a source of support for research. To reflect the material improvements, the scientific and social life of the Mountain Research Station prospered. During any summer between 1969 and 1979, between five and eight visiting scientists with their families, high school students, undergraduates, and graduates ensured a full house (often numbering in excess of 60 persons); an evening lectures series, two or three times a week, packed the Megaron; Station Manager, summer work crew, chief cook, and two assistants ensured a viable and enjoyable camp life, enlivened by evening volleyball, which early in the season tested the stamina of some of the more enthusiastic youngsters unaccustomed to 3,000 meters altitude; and a family of friendly but hungry bears were regular visitors.

Other MRS problems remained. Perhaps the most intractable, at least for a time, was the issue of public access onto Niwot Ridge, mainly four-wheel drive vehicles up the ridge route from the station itself, a historic public “right-of-way,” and also other trails. A particularly serious problem was that riding enthusiasts allowed their horses both to fer-

tilize and to crop the IBP Tundra Biome plant productivity plots above treeline. Attempts to close the road at the MRS were initially opposed by the NFS, since most of the territory lay within U.S. Forest Service land. Resolution was eventually achieved, later solidified by the Biosphere Reserve designation. INSTAAR’s own efforts to ensure minimum tundra impact by its own researchers knew no bounds! The most impressive effort was to use, courtesy of the U.S. Air Force, a Chinook helicopter and a Skycrane to put in place a San Diego State University trailer loaded with instruments from the lab or Philip C. Miller to take photosynthesis and water balance measurement, and to retrieve it again at the end of the summer observation season!

1977–1979: NASA to the Rescue

An unusual research venture was prompted by NASA that initiated early ERTS mapping and a Satellite Data Collection Platform on Niwot Ridge. After the first few years of limited research funding, so many research proposals were being funded that we agreed upon a moratorium on additional new funding because we sensed we were over-committed. Ironically, while the faculty meeting that reached this conclusion was in progress, we received a telephone call from NASA, out of the blue: would we apply for a large research contract under the generic title of “Application of space technology to the solution of real world problems”? The caller was Joe Vitale, NASA program manager, who would not accept our initial refusal and it became apparent that NASA had already decided to award the contract upon our request. There followed a cautious, How much and when must we have the proposal submitted? The answer was \$100,000/year, on the strength of a single page of written intent, to be received in Washington, D.C. by the end of the following week. Thus, with a

degree of hilarity, began our application of remote-sensing technology to natural hazards research and mountain land-use planning, that ended with the accumulation of over a million research dollars and outstanding contacts with many of Colorado's mountain counties. Dr. Vitale proved a remarkable sponsor, advisor, and natural comedian—he insisted that we stay within the required definition of “remote sensing” provided a certain Hasselblad camera could be kept at least five feet off the ground! Amongst many practical results, this remarkably relaxed contract produced some impressive state, county, and township land-use planning legislation: as one example, the town manager of Vail declared that we had changed the appearance of Vail until far into the next century.

Later phases of the NASA contract focused on the Front Range and the MRS. Amongst many other results was the shaded relief contour map of our primary field area, scale 1: 50,000, the shaded relief being produced in the world's foremost mapping laboratory—Swiss Landestopographie, Bern. The NASA experience also brought us into fruitful collaboration with the Laboratory for the Applications of Remote Sensing (LARS), Purdue University, and introduced INSTAAR to ERTS and increasingly sophisticated remote sensing.

Other initiatives during the 1967–1979 period

A Scientific Advisory Committee was set up in 1968, bringing to the Boulder campus at least once a year a distinguished group of scholars to discuss and advise upon the evolving INSTAAR program. With the growing international reputation of the Institute an increasing number of eminent arctic and alpine specialists from overseas came to us as visiting scholars. These included, amongst others, Dietrich Barsch, Geoff Boulton, Colin Burrows, Friedrich-Karl Holtmeier, Cuchlaine King, David Sugden, Robert Vivian, and Peter Wors-

ley. Close relations were developed with NCAR, especially through Doug Lilly, Harry van Loon, Warren Washington, and Ed Zipser. With Roger Barry's input, this led to one of the first attempts to use the growing power of NCAR computers to model the global climatic effects of the Laurentide and Scandinavian ice sheets; it became the doctoral dissertation work of Jill Williams (Jaeger) in 1974. Other NCAR cooperative theses included Waltraud Brinkmann (1973), Ellsworth LeDrew (1976), Jeff Rogers (1979), and later, Gerry Meehl (1987), and Susan E. Marshall (1989).

Pat Webber and a group of graduate students initiated important applied plant ecology research to studies of the environmental problems of the Trans-Alaska Pipeline. The arctic-alpine relevance was capitalized upon in terms of alpine and arctic treeline studies, developed by Harvey Nichols and expanded by Susan Short, with strong links to the Smithsonian Institution through fieldwork in northern Labrador, and by Kathy Hansen and Deborah Elliott, with close association with the Tree-Ring Dating Laboratory in Tucson. Martha Andrews initiated what subsequently became a significant contribution to Arctic bibliography. Giff Miller produced some of the earliest work on amino-acid racemization and, with John Andrews, established INSTAAR as a force for dating of postglacial substrates.

Perhaps the most lasting products of the 1967–1979 period have been the founding and flourishing of *Arctic and Alpine Research* as one of the world's leading quarterlies in its field, the editing and production of the 999-page benchmark *Arctic and Alpine Environments* (Ives and Barry, eds. 1974, Methuen), and Roger Barry's unparalleled *Mountain Weather and Climate* (Methuen, 1981), now in its second edition (1992) and translated into Russian and Chinese. The international fame of the Mountain Research Station is also worthy of special mention; it became the model

for the Tien Shan Field Station. Nevertheless, the 1967–1979 period began and ended in a most prosaic manner—one dean (Archer) averred that Ives had induced him to build the most expensive ‘john’ in the Rocky Mountains, while another dean (Lipetz) protested in vain the inexplicable cost of putting a new roof on the John W. Marr Alpine Laboratory.

1979–1986: The Years of Transition and Reflection

Pat Webber was appointed director in 1979, following a brief period of internal unrest in the Institute. The unrest was the result of distrust among the members of the fine team of scientists that Jack Ives had gathered soon after his appointment. The once-young team of Institute members had matured, one might even say had fledged, over the decade since coming to Boulder and were in need of more independence from Ives’ strong style of leadership. Each member of the team remains to this day very grateful to Ives’ vision, leadership, entrepreneurship, and tenacious loyalty to his followers and the opportunity that he provided for their careers in the United States. It can be said that John Marr made the opportunity to link and compare alpine and arctic environments by founding the Institute and that Ives built the strong foundation upon which today’s Institute is based. The Ives team of John Andrews, Martha Andrews, Roger Barry, Nel Caine, Rolf Kihl, Harvey Nichols, Kathleen Salzberg, and Pat Webber were a formidably tight group of friends who thought alike and together they covered a large portion of the spectrum of the natural science of cold environments. Their effort under Ives’ leadership built a strong national and international reputation for INSTAAR, a strong graduate training program helped equip the laboratories, and expanded the INSTAAR Reading Room and the Mountain Research Station.

Towards the end of the 1970s INSTAAR was entering a plateau of activity and enthusiasm and some were heard to say that INSTAAR had reached its zenith. This situation along with the unrest made it ripe for new leadership and the exploration of new directions and ways of operating.

Webber was appointed director under the strangest of arrangements. To solve the internal personal strife, the Institute was dissolved by the Chancellor Russell Nelson and instantly re-formed with Webber as director and sole member with the admonition to report to a council composed of the chairs of the three cognate departments (geography; environmental, population and organismic biology; and geological sciences), plus the chair of astrophysics, and to recruit a new membership. Misha Plam, director of the Mountain Research Station and Kathleen Salzberg, managing editor of the journal *Arctic and Alpine Research* continued to report to the INSTAAR director. Thus began the third edition of the “instant” Institute. Webber’s task was to recruit qualified faculty from across campus. Naturally most of the former members of INSTAAR were re-elected to the Directorate although within two years Ives and Barry decided to leave. Some new blood was recruited, for example, Peter Birkeland (pedology), Erik Bonde (plant ecophysiology), Cindy Carey (ornithology), Norman French (systems ecology), Steve Forman (thermoluminescence dating), David Greenland (climatology), Jim Halfpenny (vertebrate ecology), Vera Komárková (plant ecology), Vera Markgraf (paleoecology), Mark Noble (plant ecology), and Susan Short (palynology). Webber’s task was helped by the re-adoption with small modifications of the INSTAAR Charter and By-laws built in the last years of Ives’ leadership in which the Institute was to be operated as a “Directorate” of voting members.

Webber’s intent upon becoming director was only to oversee the re-formation and to

persuade the University administration to recruit a high-quality new director from beyond the University of Colorado. This goal was finally achieved in 1986 with the arrival of Mark Meier.

The re-formed INSTAAR was critically different from its antecedent in that all faculty salary lines, with the exception of that of the director and director of the Mountain Research Station, were transferred to the cognate departments or the College of Arts and Sciences. This had the potential to reduce the role of the INSTAAR Directorate in replacing its faculty should they leave. The loss of salary lines has not been altogether a negative outcome since it provides an incentive for good relationships and citizenship in a cognate department where an appreciation for the mission of INSTAAR can be fostered. Further it allows members of the INSTAAR Directorate to participate in departmental leadership. Regarding the latter it is significant that Nel Caine, David Greenland, John Andrews, and Gifford Miller all have taken turns at chairing, with distinction, their various academic homes leading without doubt to stronger departmental-institute understanding and collaboration.

Another critical difference in the re-formed INSTAAR was the lamentable migration of the World Data Center for Snow and Ice and its Director Roger Barry to CIRES. This was regrettable since climatology was fundamental to the John Marr's vision of INSTAAR and snow and ice research remains an important part of the INSTAAR mission. The cornerstone Front Range climate measurement program continued within INSTAAR with the efforts of John Clark and David Greenland and on John Clark's retirement the recruitment of Mark Losleben. The Niwot Ridge carbon dioxide measurement program supported by NOAA continued and this complements, as a mid-latitude site, the famous Mauna Loa, South Pole, and Barrow (Alaska)

records that have documented the global rise of greenhouse gases.

Like most modern field-based research enterprises, INSTAAR's research history can be traced along the continuum from descriptive, multidisciplinary small-scale approaches to interdisciplinary, systems and larger scale approaches. Along this continuum there is also a trend from pure observational and inferential science to a more experimental and causal approach that embraces new technology. The period from 1979 to 1986 marked a change towards increased team research involving a systems emphasis with experimentation and increased use of technology. These changes are exemplified with the establishment, in 1980, of the present day Long-Term Ecological Research (LTER) program on Niwot Ridge (as one of the six original LTER sites) and the Center for Geochronological Research. The LTER program built on the history of ecological research on Niwot Ridge, including the U.S. IBP Tundra Biome and the long climate records collected that the environmental measurements stations going back to 1952 on Niwot Ridge. LTER is sustained by major funding in five-year increments by the NSF and, in 1985, the Center was supported by a University Enrichment grant. The LTER program involved faculty in the Departments of Environmental, Population and Organismic Biology, Geography and Geological Sciences and concerned the long-term dynamics and function of Colorado mountain ecosystems with special relevance to monitoring and understanding processes related to both anthropogenic and natural causes. The first formal report of the LTER program, based at the Mountain Research Station, was published in 1982 in the INSTAAR *Occasional Paper* series as *Ecological Studies in the Colorado Alpine: A festschrift for John W. Marr* to mark the renaming and rededication of the Alpine Laboratory as the John W. Marr Alpine Laboratory after extensive remodeling. Gifford Miller was the leading force for the Center which was seen as

a University-wide facility. Thus LTER and the Geochronology Center served to integrate INSTAAR more closely with the rest of the University. Both enterprises led to the boost in the use of technology. INSTAAR obtained its first word-processing system and PCs, upgraded the Sedimentology Laboratory, established a water analysis and soil chemistry capability at the Mountain Research Station, and became a pioneer in tundra mapping and GIS methods. The Center with its penchant for the analysis of biologically important molecules such as amino acids, oxygen, water, and carbon dioxide was poised to enter the realm of stable isotope analysis and address important biogeochemical questions relating to global change.

Another trend in science during this period was the recruitment of more women as principal investigators. INSTAAR paralleled this trend by welcoming the first women to the INSTAAR Directorate. These were Vera Markgraf, Vera Komárková, and Sue Short. Regrettably, they could only be sustained with soft money from grant activities but such recruitment was appropriate and vitally important. Kathleen Salzberg and Martha Andrews continued to contribute in important ways to operations, research, and fund raising.

The Webber years provided a chance to examine the role of INSTAAR and to build on the Marr and Ives legacies and lay foundations for a continuing institute. It remained clear that the niche that INSTAAR occupied in the polar and mountain research world was critically useful to contribute to the solution of the emerging issues concerning climate change and land use and land cover change. It may be said that INSTAAR endures today as a result of this period of stock taking, stewardship, and husbandry.

1986–1988: Global Change and New Directions

The 1982–83 INSTAAR Program Review had recommended the recruitment of a new director. Dr. Mark F. Meier was selected after a national search, and he assumed the directorship as well as a professorship in geological sciences in November 1985. Meier had been chief of the Project Office—Glaciology, U.S. Geological Survey and research professor of geophysics at the University of Washington. He had been active in national and international scientific programs in snow and ice, hydrology, and global change; his research included sites in the mountains of Wyoming, Alberta, Washington, and Alaska, as well as in both polar regions.

At the time of Meier's selection, the Institute had an active research program with emphasis on Quaternary studies, geochronology, and mountain and arctic ecology. The core of this research program included nine Ph.D.-level research associates but only three regular faculty members (Andrews, Caine, and Webber). One obvious need was to expand the numbers of faculty. Dr. Gifford H. Miller, who had successfully created a Center for Geochronological Research through a competitive University Enrichment Grant in 1985, was appointed a full-time associate professor of geological sciences in 1986. A national search for a light stable-isotope geochemist led to the appointment of Dr. James W. C. White in 1988. Thus the number of regular faculty was quickly doubled.

Additional research associates (now research scientists) were appointed in the 1986–88 period. New personnel associated with the Center for Geochronological Research included Dr. Steven L. Forman, who established a thermoluminescence laboratory; Dr. David K. Yamaguchi, who set up a dendrochronology laboratory at the Mountain Research Station; and Dr. Robert C. Walter,

who was recruited away from INSTAAR by the University of California-Berkeley. James White set up a light stable-isotope laboratory and cooperated with Professor Lang Farmer of the Department of Geological Sciences in the establishment of a heavy radio-isotope laboratory; funding was obtained for an accelerator mass spectrometry laboratory, all as part of the growing Center for Geochronological Research. New names appeared on the roster of those involved in the Institute's Long-term Ecological Research (LTER) program, including Dr. Norman R. French, who modeled alpine ecosystems; Dr. David W. Inouye, who specialized in plant population ecology; and Dr. Michael (Iggy) Litaor, who studied the effects of acid deposition on soils and ecosystems. In 1987 Patrick Webber took a leave of absence to become a program director for ecology at the National Science Foundation. Subsequently (1989) he was recruited by Michigan State University. Dr. W. Tad Pfeffer, a glacier dynamicist, joined the glaciology program begun by Meier; Dr. Kirsten M. Williams, an expert on diatoms, joined the Quaternary studies group; and Dr. Mort Turner, former program officer for Polar Earth Sciences at NSF, brought his research on archeological geology to INSTAAR.

Research and educational accomplishments during this period were many. A new thrust was based on the evolving national and international global change program. Professor Meier had been involved in developing the concept of an International Geosphere-Biosphere Programme, more simply known as Global Change, before coming to the University of Colorado. He also worked with others to emphasize the importance of the Arctic in Global Change to the National Science Foundation and other agencies. The NSF created the Arctic Systems Science program; this new initiative has benefited INSTAAR researchers, and a number of Institute scientists, including John Andrews and Jim White, also participated in

the development and management of components of this program during its early years. Mark Meier and Giff Miller also instituted a two-semester course on global change for nonscience majors, which continues to have high enrollment.

Ecosystem science continued to prosper during this period, both in northern Alaska and in Colorado. Participating in a large group sponsored by the Department of Energy, Drs. D.A. (Skip) and Marilyn Walker developed concept and infrastructure for a geographic information system approach to assist in the modeling of Alaskan north slope ecosystem changes. They also showed that very different plant successions occur on pingos, the only places where steep slopes occurred on the coastal plain. The University's LTER program, based at Niwot Ridge above the Mountain Research Station, continued to address questions of biotic nonequilibrium and the resistance and resilience to disturbance. An unusual event—a population explosion of voles under the snow during the 1987–88 winter—provided a unique opportunity to observe the impact of disturbance on the soils and ecology in an alpine region.

Dr. Tad Pfeffer, Prof. Tissa Illangsekare (Department of Civil, Environmental, and Architectural Engineering), Prof. Mark Meier, and students developed a first attempt at a numerical model to understand the process of meltwater infiltration into cold snow, of importance to predicting the timing of sea-level rise due to global warming. Meier and colleagues at the California Institute of Technology, University of Washington, and U.S. Geological Survey drilled through the fast-moving Columbia Glacier to measure fluctuations in subglacial water; they also measured the speed of flow at 10-minute intervals. These results showed that both pressure and thickness of subglacial water affected glacier sliding, thus answering old questions but raising new ones in this poorly-understood but important process.

A wide variety of accomplishments in the fields of Quaternary stratigraphy, chronology, and ecology took place during these years, aided by new laboratory facilities. John Andrews and his group began to turn more toward ocean sediments for paleoclimatic records. This included cruises in Hudson Strait, Baffin Bay, and off East Greenland collecting seismic data as well as magnetic, isotope, foraminifera, and diatom evidence in sediment cores, which allowed them to deduce the stratigraphy, sediment flux, and changes through time during and after the last glacial event. Similar studies on lake sediments north of Hudson Strait and in Spitsbergen established the pattern of deglaciation on land in these regions, as well as to determine the timing and amount of postglacial rebound (uplift of the land following the removal of the large ice sheets).

Changes occurred at the Mountain Research Station during the 1986–1988 period. Largely through the efforts of MRS Director Mark Noble, money was raised from NSF and the University to add a second story to the Marr Laboratory. During the engineering design, however, it was discovered that the walls, ceiling, and floor were up to 85 percent asbestos! Consequently, the money was spent to remove everything except roof and foundation, and to rebuild the laboratory as a safer and more aesthetically pleasing structure (but still a single story), complete with handicap access. The renovated John W. Marr Alpine Laboratory was rededicated on 6 June 1988, with Dr. Marr in attendance. In addition, the Kiowa building was outfitted as an analytical chemistry laboratory. Mark Losleben served as acting director of the station during the trying construction period, and Professor David Inyoue, from the University of Maryland, became director of the station in 1988.

Administrative improvements—and crises—also marked the 1986–1988 years. Budgeting and planning systems were established, and new cost accounting procedures

were put in place. A Scientific Advisory Committee was reappointed and began visits to the Institute to advise the director and the Directorate, and to inform the Graduate School of INSTAAR's problems, accomplishments, and opportunities. Nicely illustrated Annual Reports and other outreach activities were developed to spread knowledge of INSTAAR and its research accomplishments within and without the University. The Joint Facility for Regional Ecosystem Analysis was created by Skip and Marilyn Walker, with cooperative ties to the Center for the Study of Earth from Space/CIRES at the University of Colorado and the Natural Resources Ecology Laboratory at Colorado State University. Unfortunately, the Mountain Research Station incurred some very large debts due to a combination of factors, not all under control of the station directors. The University's Department of Facilities Management took over the maintenance of the station's buildings. INSTAAR had to assume a sizeable loan to retire the debt, which impacted some of the Institute's planned new activities.

1989–1992: The “Cosmic Agreement” and Major Expansion

The research productivity of INSTAAR scientists continued to increase during these years, but some strains appeared between the Institute and some other units of the University, due in part to the MRS debt and a view by the administration that too much of the Institute's research effort was being performed by nonfaculty Research Associates rather than regular faculty. Fortunately, a normal Program Review had been scheduled for 1988–89. This gave the Institute an opportunity to articulate its successes and the benefits it provides the University, the State and Society, and to have this recognition authenticated by high-level internal and external panels. The result of this review was

highly positive; and several additional faculty hires were authorized. Shortly thereafter, a “cosmic agreement” involving two institutes, two departments, and two schools was negotiated, resulting in the hiring of a senior-level biologist to lead the LTER program (Prof. Timothy R. Seastedt, from Kansas State University), a new faculty member to direct the Mountain Research Station (Prof. William D. Bowman, from University of Colorado), and an alpine biogeochemist and hydrologist (Prof. Mark W. Williams, from University of California–Santa Barbara). In addition, Dr. Jonathan T. Overpeck, palynologist, came to Boulder from the Lamont-Doherty Earth Observatory of Columbia University to direct the new NOAA Paleoclimate Program and join the INSTAAR Directorate, together with Dr. Julie Cole. Professor William B. Krantz of the Department of Chemical Engineering of the University of Colorado joined INSTAAR to work on permafrost problems. INSTAAR now counted nine regular faculty and up to seventeen research associates and research faculty on its Directorate.

As the number of individual scientists at INSTAAR increased, so did its scientific productivity. Because of the breadth of this activity; only a few highlights will be mentioned here. The LTER program, which had begun in 1980, successfully weathered an exhaustive review, and was renewed through 1998. This program allows scientists to conduct short-term experimental manipulations against a background of long-term descriptive and monitoring measurements, so that we can better understand the biologic organization of tundra, how the ecosystem functions, and what changes we can expect in the future. The LTER group now includes, in addition to new INSTAAR faculty (Bowman, Seastedt, and Williams), scientists, researchers from the Department of Environmental, Population, and Organismic Biology, the National Center for Atmospheric Re-

search, and the University of Colorado at Denver. Accomplishments by the LTER team included publication during the 1989–1992 period of an updated climate analysis, as was an overview of dry deposition and the continuation of long-term data sets on climate, snowpack, water flow, biogeochemistry, atmospheric chemistry, biological productivity, phenology, and decomposition. While temperatures along the base of the Front Range have been rising for the past 20 years, the alpine tundra is cooling and becoming wetter. This is increasing the contrast with lower altitude sites. Numerical models have been developed to simulate the cycling of carbon and nitrogen in the tundra. Nitrogen is a key element in plant growth, and the LTER team has shown that plant productivity and species compositions can be altered by nitrogen additions, that seasonal additions of nitrogen demand and use vary across the tundra landscape, and that alpine plant species may be contributing to nitrogen limitation by locking the element away in root tissues. Another research project addresses the crucial role of snow in the hydrochemistry and biogeochemistry of these seasonally snow-covered areas.

The Joint Facility for Regional Ecosystem Analysis led by Skip and Marilyn Walker developed hierarchical geographic information systems (GIS) to analyze landscape ecological changes at various scales for both the Colorado alpine and the Alaskan Arctic. These systems were designed to address a number of scientific questions including natural and human-induced disturbances in arctic and alpine landscapes, the processes involved in landscape evolution, and long-term studies including effects on the ecosystems of global climate change. These GIS studies bridge the spatial scales from individual experimental plots to large regions and allow the use of remote sensing to expand the scale of spatial data. Among other results, these researchers showed that carbon

stored in the soils and the biomass above ground increases with the age of the terrain on glacial/nonglacial surfaces in Arctic Alaska, and that the dust derived from roads in this area affected the biomass and species composition of the tundra.

Stable isotope-based research became especially active during the 1989–1992 period. Professor White in concert with a team of graduate students, post-docs and cooperating NOAA scientists, addressed a wide range of issues including the global carbon budget using the isotopic signatures of carbon dioxide and methane. These projects identified global sources and sinks of carbon dioxide which are important to projections of future greenhouse gas loading. Deuterium and oxygen-18 ratios in the atmosphere and in ice cores were found to make it possible to reconstruct conditions at the oceanic moisture source as well as at the precipitation site. These results were used to determine the paleoclimate of the North Atlantic region, including the history of the North Atlantic (climate) Oscillation from analyses of ice cores obtained from the Greenland Ice Sheet Project 2.

Innovative studies of carbon and hydrogen isotopes in peat and mosses by Jim White and Vera Markgraf and others has broadened our understanding of paleoclimatic change in southern South America. These studies have been shown to yield estimates of both terrestrial temperature and humidity, as well as improved values of the concentration of carbon dioxide in the atmosphere. Vera Markgraf, using paleoclimatic records from Southern Hemisphere land masses, found numerous high-amplitude changes that could not be explained by large-scale atmospheric circulation scenarios such as the controversial Younger Dryas event. Gifford Miller found outstanding preservation of amino acids in the egg shells of large flightless birds (ratites), and these shells that these can be used for amino-acid geochronology and paleo geochemistry of

many hominid sites in Africa. Giff Miller and colleagues collected paleoclimatic evidence from terrestrial and marine sites in the remote Franz Josef Archipelago, which allowed them to reconstruct the late Quaternary history of this interesting area. Jonathan Overpeck and Julie Cole, together with Drs. Robin Webb and David Anderson of NOAA, embarked on a series of fruitful high-resolution paleoclimatic projects using tree rings, lake and ocean sediments, and coral growth data; and they used their results together with general climate models (GCM) to reconstruct environmental changes at both low and high latitudes.

The quality of INSTAAR's research was affirmed by honors received by Institute scientists during this period. In addition to numerous invited lectures in many different countries and service on scientific advisory committees, we highlight the following: John Andrews's work was included in the Annual Geoscience Highlights of the American Geological Institute. He was co-chair of the National Science Foundation's initiative Paleoclimates of Arctic Lakes and Estuaries (PALE). He also participated in a NATO Advanced Studies Institute on Earth Rheology and Glacial Isostasy in 1990 and in another NATO Institute, with Mark Meier, on Ice in the Climate System in 1992. Martha Andrews was elected Chair of the U.S. Polar Information Working Group. Julie Cole was co-convenor of an international workshop on Coral Records of Climate Change. Scott Elias was a visiting professor at the University of Alaska–Fairbanks, and authored the book, *Quaternary Insects and Their Environment*. Vera Markgraf chaired a new National Science Foundation paleoclimate initiative, Pole-Equator-Pole; she also coordinated a symposium of the International Palynological Congress, and was co-editor of a book *El Niño: Historical and Paleoclimatic Aspects of the Southern Oscillation*.

Mark Meier participated in the development of the Arctic Research Consortium of the U.S. (ARCUS) and became President-Elect and Chair of the Board of Directors, and chaired the Land-Atmosphere-Ice Initiative of the National Science Foundation's Arctic System Science (ARCSS) program, developed and co-chaired a program on Freshwater, Land, and Biological Interactions at the Aspen Global Change Institute, and was a delegate to the U.S.–Japan Bilateral Program on Global Change. Giff Miller was a member of the steering committee of two international interdisciplinary workshops on environments of the last interglacial and on the PALE initiative. Jonathan Overpeck was a member of the Steering Committee for PALE as well as the International Geosphere-Biosphere (IGBP) core project on Past Global Changes (PAGES). Tim Seastedt was elected to the National Executive Committee of the LTER program. Mort Turner and Joanne Turner were invited to a symposium on the paleoecological aspects of early man in Novosibirsk and to participate in field studies in the Altai Mountains of Siberia. Skip and Marilyn Walker were invited to participate in a joint U.S.–USSR program on environmental protection in the permafrost lands of northern Siberia, and Marilyn Walker co-chaired the development of the International Tundra Experiment (ITEX). Professor White became chair of the U.S. Ice Core Working Group, served on the Steering Committee of IGBP-PAGES, and on the International Atomic Energy Agency's Expert Committee on Trace Gases. Thus INSTAAR people have honored, and because of this, participated in the formation of several new scientific initiatives.

New laboratory facilities were developed both at the Mountain Research Station and at INSTAAR in Boulder. A new tundra laboratory was built above treeline to facilitate LTER and other studies in the alpine zone, especially in the winter. Also, the dining hall at the Mountain Research Station was exten-

sively renovated at this time. An Accelerator Mass Spectrometry Radiocarbon laboratory was set up in Boulder by Dr. Tom Stafford, as was an Image Analysis Laboratory by Jonathan Overpeck, and several additions to the ecology and biogeochemistry laboratories by Tim Seastedt and Mark Williams. A cold laboratory for snow studies was equipped in RL6 in Boulder by Tad Pfeffer.

1993–1994: National Ice Core Laboratory and Other Research Activities

With the continuing addition of new personnel, new laboratories, visiting scientists, and increased grant support, INSTAAR was a busy place, and was rapidly outgrowing the space it had in RL1 in Boulder. New personnel included Dr. Ute Herzfeld from the Scripps Institution of Oceanography, who is well known in the field of Geomathematics. Perhaps the largest addition to INSTAAR's responsibility at this time resulted from a successful proposal to build and run a National Ice Core Laboratory (NICL). The rich content of environmental data captured in polar ice was yielding striking new insights into the history of climate and environmental change. This 64,000-square foot, 3-million dollar laboratory contains large cold rooms for archives and working spaces, and is located in U.S. Geological Survey space in the Denver Federal Center. It came into being through a cooperative agreement between INSTAAR, the U.S. Geological Survey, and the National Science Foundation. NICL was dedicated in a national ceremony on 3 August 1993. Mark Meier was Director of NICL, Tad Pfeffer scientific coordinator of NICL, and Jim White was chair of the Ice Core Working Group. Dr. Joan Fitzpatrick of the USGS was technical director and the person who was most closely involved in the planning, construction, and operation of NICL; and Geoffrey Hargreaves

and Alan Bol were curators. Once fully operational, the academic direction of NICL passed to the University of New Hampshire.

A few highlights of the productive research programs of INSTAAR during the 1993–1994 period follow: Studies by Institute scientists together with colleagues from the Bedford Institute of Oceanography in Canada, Lamont-Doherty Earth Observatory of Columbia University, and several European institutions found that the collapse of the North American Ice Sheet was unusual and caused events of global significance. The INSTAAR contributions, by John Andrews and Giff Miller and their students, noted that late glacial and Holocene ice-sheet activity could be observed in sediments deposited on continental shelves. Their observations of detrital carbonate layers matched those in the open Atlantic, indicating massive outbursts ('armadas') of icebergs, perhaps due to periodic instabilities (surges?) of the Laurentide Ice Sheet, the so-called Heinrich Events. Studies on land showed that rapid advances of the ice sheet across Hudson Strait were followed by intense iceberg calving and rapid retreat. A numerical model of ice flow from a center in Labrador/Ungava was developed by Tad Pfeffer, lending credence to the glacial geologic results.

Paleoenvironments and the timing of inundation of the Bering Land Bridge were subjects for research by Scott Elias and Susan Short, together with colleagues from the USGS and other institutions. Using cores from the Bering and Chukchi Seas and neighboring terrain in Alaska, they found a mosaic of different ecological environments instead of the presumed dominance of a hypothesized steppe-tundra. By accelerator mass spectrometric (AMS) dating of individual in situ insect fragments, they were able to establish a more reliable and accurate data on the timing of the inundation of the land bridge.

Alpine ecosystems are similar in many ways to those in the Arctic. However, the alpine landscape consists of islands of cold-adapted ecosystem surrounded by a sea of temperate-zone biota, temperate-zone human activities, and bathed in an atmosphere enriched with industrial contributions of both regional and global origin. Studies of this ecosystem by the LTER team led by Tim Seastedt during the 1993–1994 period led to the following findings, which are related to the current trend of cooling and increasing precipitation: (1) enhanced snowpack results in increased nitrogen return to the atmosphere; (2) enhanced snowpack causes unique, transient patterns of change which cannot be inferred from study of plant communities that have developed during stable climatic conditions; (3) inorganic enrichment of nitrogen is occurring in these watersheds even though the plants are capable of retaining excess nitrogen; (4) enhanced snowpack appears to cause increased gopher densities and their impacts on the ecosystem; and (5) analysis of how the tundra ecosystem has changed in response to climate changes of the past provides insight as to how it will likely change in the future. These researches have included the construction of a large snowfence on Niwot Ridge, which causes increased snow deposition in certain areas and reduced snowpack in others, but it will take time to effect appreciable ecosystem change.

Ice cores from the Greenland Ice Sheet provide a high-resolution record of climate change over the last 150,000 years. Jim White and colleagues in INSTAAR and in other U.S. universities, Denmark, and Iceland found major and remarkably rapid climatic changes in the ice core record. Using hydrogen and oxygen isotope data, they found that the termination of the last cold spell, termed the Younger Dryas, was a warming of at least 7°C. In a few decades—a human life span. Electrical conductivity

records and annual precipitation measurements on these cores by others suggested that this warming may have taken place in only a few years. These results call into question most existing theories of ice-age evolution, and are not yet clearly explained. Such rapid changes in climate do, however, send a signal to humanity that we should be cautious about assuming that all climate change, including that to be expected in the future, is always a gradual process.

The ice-core history determined by Jim White and colleagues from one Greenland drilling site (GISP2) match the history found by a team of Europeans at a nearby site (GRIP) down to about 120,000 years before the present. Below this point the apparent histories are quite different; this suggests that the simple historical record has been confounded by peculiar ice deformation near the bottom in one or both cores. This points to the need for improved understanding of basic ice dynamics. Tad Pfeffer with his students and in cooperation with a team from the University of Wyoming measured ice deformation in many drill holes through a small glacier in Alaska, and used 3-dimensional radio-echo sounding to determine the bedrock geometry in detail. The 3-dimensional velocity and deformation data show that the pattern of flow is complex, and that it cannot be accurately predicted from measurements only on the surface. This confirms earlier theoretical work at INSTAAR by Dr. David Bahr.

Recognition of the quality of achievements by INSTAAR's scientists continued apace, with numerous requests for editorships, invited lectures, service on workshops, and symposia chairmanships. In addition, John Andrews co-organized a PALE Principal Investigators meeting; he organized another Arctic Workshop, the 24th, at INSTAAR in Boulder. Martha Andrews received the Alaska Historical Society Pathfinder Award. Professor Caine was selected as the Frost Lecturer before the

British Geomorphological Research Group, and received the G. K. Gilbert Award for Excellence in Geomorphological Research by the Association of American Geographers. Julie Cole was elected to the steering committee of the National Science Foundation's initiative, Marine Aspects of Earth History (MESH). Ute Herzfeld won the President's Prize of the International Association for Mathematical Geology, and a Heisenberg Fellowship from the German Science Foundation. William Krantz was elected President of the Southwest and Rocky Mountain Division of the American Association for the Advancement of Science (AAAS). One of his students, Katherine E. Adams, received the First Place Award in the National Student Technical Papers Competition at the Annual Meeting of the American Institute of Chemical Engineers.

Vera Markgraf coordinated the first meeting, in Panama, of the global change initiative Pole-Equator-Pole Paleoclimates of the Americas (PEP1). Mark Meier was elected chair of the Board of Directors of ARCUS, and was designated a lead author for sea-level changes of the Intergovernmental Panel on Climate Change Second Scientific Assessment (IPCC). He also gave the John Wesley Powell Memorial Lecture at the Southwest and Rocky Mountain Division of the AAAS, and was keynote speaker at the 100th Anniversary Celebration of the International Commission on Snow and Ice. Kathleen Salzberg was president of the Association of Earth Science Editors. Tim Seastedt was elected secretary of the Association of Ecosystem Research Centers. Mort Turner was chair of the Scientific Council of the Center for the Study of the First Americans; two major publications on Antarctic geology were dedicated to him.

Mark Meier, who had served as director of INSTAAR from late 1985, indicated his intention to step down as director in 1994, but to continue as a professor of geological sciences. Professor Nel Caine served as act-

ing director while an international search was organized. A successful search for a new biogeochemist was held at the same time.

1995–2000: Preparing for the 21st Century

Upon reflection on the rapid expansion of INSTAAR personnel and research operations during the years with Mark Meier at the helm, INSTAAR recognized that it was no longer the small and cozy Institute of the 1950s and 1960s. The choices were clear, either the Institute had to limit growth, or develop new infrastructure to preserve the sense of community yet provide for future opportunities.

These choices squarely faced the new institute director, James P. M. Syvitski, who took the helm in 1995. Professor Syvitski, who was also appointed as a tenured professor in geological sciences, was widely recognized for his pioneering studies involving sediment transport physics, oceanography and hydrology. James Syvitski was a senior scientist at the Bedford Institute of Oceanography and was holding adjunct professorships at four Canadian universities, at the time of his hire. He immediately recognized two key problems affecting the Institute. Firstly, rapid growth during the early 1990s created an atmosphere of what became affectionately known as the “space wars” period. Secondly, university resources were continuing to dry up as the nationwide drop in undergraduate student enrollments continued. In demographic terms, this refers to the period between boomers and echo-boomers. Decreasing university resources created a sense of “them vs. us” on campus, as the seven research institutes (CIRES, LASP, JILA, INSTAAR, IBG, IBS, ICS) continued to expand during a general contraction of the university budget. To a large extent, the CU research institutes dominate the CU-Boulder research infra-

structure: they generate more research dollars than all other CU schools and colleges combined.

To deal with space needs, the institute needed to expand by hook or crook, while cramming more people and operations into its limited facilities. Some labs and personnel were temporarily located in the Nuclear Physics Lab, others in research buildings RL2 and RL6, while parking-lot trailers were employed for storage. The Scientific Advisory Committee effectively criticized the university for the lack of safe laboratory space during this period. In 1999, with NOAA relocating to a new Broadway site beside NIST, research space in RL3 became available. When renovations were completed, 10,000 sq ft of new office space was made available to INSTAAR, with another 6,000 sq. ft. of laboratory space in RL1, bringing the total Institute research space to 45,000 sq. ft. in RL1 and RL3.

The ever-decreasing level of campus support also forced the INSTAAR to become much more independent in dealing with its own growth and future. For example, the Institute soon found itself self-funding its research accountants and system administrators through a tax on its research grants. Despite asbestos mitigation work done earlier in RL1, the Institute still had to deal with its 1950s asbestos-laden space in RL1 as any environmentally-sensitive institute should. A grant from the State of Colorado did allow RL1 to become more friendly to those with disabilities, including the installation of an elevator.

While the Institute improved its facilities on the East Campus, the Mountain Research Station continue to grow and improve as well. For example, the Marr Alpine Lab was substantively remodeled in 1997. The first stage of construction of the Fireweed Hostel was completed in 1999. This 3,600 sq. ft. building will provide a meeting facility for up to 70 people, a full kitchen, several bathrooms, and winterized sleeping quarters for

32 people. The Tundra Lab at 11,565 ft (3,525 m) was wired with fiber-optic lines donated by AT&T and high voltage power lines, allowing year-round research in a region where winds can approach 160 mph (68 m/s) and the wind-chill can approach as low as -70°C . The effort was supported by 75 volunteers of the U.S. Army 244th Engineering Battalion, who in 1999 returned to install a NOAA-donated, astronomical observatory-dome. In 2000, a TundraCam was installed at the MRS whereby users could sit at their web-connected computer, anywhere in the world, and steer and zoom the camera into the many Niwot Ridge vistas, while receiving live climate information. The site became so popular that it was cited in Science News as a top web site, reaching over $3/4$ million users in a little over a year. Finally two 30-m tall towers near C-1 climate station were installed to measure flux of gases (CO_2 , ozone, oxidized compounds of N, terpenes) between the subalpine forest and alpine ecotone.

To provide a framework for its new found maturity, INSTAAR in 1996/97 completely revised its By-Laws and Standing Rules, developed a five-year Business Plan and a new Strategic Plan, and its first Diversity Plan. The Program Review committee referred to INSTAAR as a "world-class institute ... with improved faculty, quality and reputation, areas of expertise, numbers of publications in prestigious journals, and a larger, more-diversified funding base." The Institute has since carried forward with this praise with development plans for moving into a planned research and teaching building on the main university campus. The Environmental Sciences Building is to be collocated with the Environmental Studies Program, the Program of Atmosphere and Ocean Sciences, and the National Snow and Ice Data Center of CIRES. A new Master Plan for the MRS also looks to the future with plans for a new academic building (new

classroom, computer lab, and support offices), a new laboratory building (wet chemistry, soil and plant laboratories), four new winterized cabins, and a greenhouse facility.

While INSTAAR continues its success in carrying out field-oriented research, it has developed national recognition for its laboratory prowess and capabilities, operating 35 highly sophisticated labs including stable isotopes, radiocarbon, sediment analysis, amino acid, four biogeochemistry labs (including the MRS Kiowa lab), cold rooms, dendrochronology, herbarium, ecosystems science, phycology, plant physiological ecology, entomology, limnology, micropaleontology, microscopy, organic carbon, paleoceanography, two palynology labs, a Past Global Change lab, permafrost lab, snow and ice lab, an oceans lab, the cold-regions Reading Room, and the Environmental Computation and Imaging Facility. Three of these labs bring in significant auxiliary funds to support their operations. The Environmental Computation and Imaging (ECI) Facility allows INSTAAR to provide global leadership in earth system modeling. The ECI Facility hosts two super computers through an award from the Office of Naval Research, and matching support from Sun Microsystems and the CU Graduate School. The Carbon-14 lab has doubled its ability to process in excess of 1,000 samples per year for the NSF Earth System History community under the careful eye of Dr. Scott Lehman. The stable isotope laboratory houses \$2M worth of mass spectrometers, within its state-of-the-art facility, and is home for six mass spectrometers, ten different sample preparation systems and a dozen computers. This environmentally friendly workplace conducts over 48,000 samples per year of air, water, and organic matter for isotopes of hydrogen, oxygen or carbon.

Funding Diversification and Personnel Changes

In the early 1990s the Institute received most (85%) of its funding from the National Science Foundation. INSTAAR has since worked to diversify, increasing its funding from other agencies: Defense (ONR, ARO), Interior (USGS), Commerce (NOAA), EPA, Agriculture, NASA, and Energy. The late 1990s also witnessed new funding from industry (Raytheon, Mobil, ExxonMobil): aerospace and petroleum companies interested in natural disaster reduction, national security planning, and reservoir characterization. Gifts from private donors and industry and foundations also increased during the late 1990s. INSTAAR now operates over 180 grants at any given time, generating about 65 new grants per year. The Institute has become a large (\$10M per year) research enterprise. As January 2001, INSTAAR had 285 personnel with 84 at the Ph.D. level (11 teaching faculty, two positions vacant, two emeritus fellows, 20 research faculty, ten postdoctoral fellows, 27 research affiliates, and 14 visiting scientists). INSTAAR employees 144 students (65 grads, 79 undergrads), 57 support and technical staff (including MRS staff and instructors, with Steve Siebold as Station Manager, and eight front office staff with Julie Hughes as the Chief Financial Officer). Between 1995 and 2001, INSTAAR personnel doubled, with a 107% increase at the Ph.D.-level, a 55% increase in graduate research assistants, a 300% increase in undergraduate student support, and a 27% increase in professional scientist support. Quaint and cozy the institute no longer is.

In preparing for the 21st century, INSTAARs knew that in addition to continuing support for its core strengths of Ecosystem and Past Global Change science, it must also strengthen its research interests in geophysics research and human dimensions of

climate change must be strengthened. To continue the support its core field of Ecosystem Science, Assistant Professor Alan Townsend formerly of Stanford and Yale, joined INSTAAR and the Department of Environmental, Population and Organism Biology in 1996 (formally in 1997). Alan is a world-class expert on global nitrogen and carbon cycling. Prof. Diane McKnight, formerly a senior research scientist with the USGS, joined INSTAAR and Department of Civil, Environmental and Architectural Engineering in 1996. She was president of the American Society for Limnology and Oceanography and is a world recognized hydrologist specializing in complex organic compounds. Dr. Patrick Bourgeron joined the Directorate in 1997 from Nature Conservancy and presently heads the INSTAAR Ecosystem Group. He continues INSTAAR's expertise in Geographical Information Systems (GIS) and applies his expertise to forestry and land-use management. Affiliates who have joined the Ecosystem Group during the late 1990s include Dr. Stephen Jackson (ecosystem science), Prof. Herman Sievering (atmospheric physics and chemistry), Dr. Cathy Tate (ecology and biogeochemistry), Dr. Hector Galbraith (ornithology), and Dr. Joan A. Kleypas (corals and climate change).

To support the Past Global Change science, Dr. Scott Lehman from the Woods Hole Oceanographic Institution, joined the Directorate as a fellow, on the strength of his renowned expertise in paleoclimatology, paleoceanography, and paleochemistry. Dr. Robert Webb, a federal scientist with NOAA, joined the Directorate in 1995 as a leading expertise in paleoclimatology and climate modeling. Dr. Connie Woodhouse, also a NOAA scientist, joined the Directorate in 1999 from the University of Arizona, and has become the resident dendrochronologist with expertise on drought. Dr. William Manley and Dr. David Lubinski, both CU graduates, joined the Directorate in

2000 after their post-doctoral fellowships, strengthening the Institute's expertise in glacial geology (GIS) and geochronology, respectively. Dr. Elise Pendall from the University of Arizona also joined the Directorate in 2000, bringing much needed expertise in soil science. Most recently (2001), Dr. Detlev Helmig (from CIRES, NCAR, and University of California-Riverside) became a Fellow of the Institute bringing expertise in polar and alpine chemistry. A search for a paleoclimatologist faculty position at INSTAAR is presently underway (2001/02). Supporting the scientists that comprise the Past Global Change Group and the Center for Geochronological Research are a group of first-rate affiliates of federal labs and other universities: Drs. Larry Benson (lakes), P. Thompson Davis (tephrochronology), Greg McCabe (glaciology and atmospheric circulation), Dan Muhs (U-chronology), Alan Nelson (Holocene history), Bob Thompson (palynology), James Turk (Quaternary dating), William Briggs (marine ostracodes), Parker E. Calkin (glacial geology), Julie Cole (coral climatology), Daniel Grossman (environmental reporting), Vladimir Konovalov (glaciology and hydrometeorology), Richard F. Madole (geomorphology), Mel Reasoner (palynology), Richard Reynolds (magnetic studies), and Eric J. Steig (glaciology).

While recognizing the importance of maintaining its core research areas, the institute embarked on a new thrust into the human dimensions of climate change. The hope was to provide for important new ways to reach the public with its award-winning science. To that end, in 1995 Dr. Astrid Ogilvie from the University of East Anglia, joined the Directorate bringing with her expertise in human dimension studies of the environmental history of Iceland and the North Atlantic during the last millennium. She explores the climate history of Iceland through the Sagas and parish reports. Dr. John Hoffecker joined in the Directorate in 1999, from DOE, bringing state-of-the-art expert-

ise in Neanderthals and early-human paleoecology. Professor James Dixon joined as a fellow in 2000, from being Curator of Archeology at the Denver Museum of Natural History, and with a joint appointment with CU Museum of Natural History. Together these researchers, with Dr. Lisa Barlow, are changing the visibility of the institute. And Scott Elias developed a CD ROM for Alaskan middle school students in an enormous outreach effort.

A major goal of James Syvitski as director was to help strengthen the rather ephemeral geophysics group, bringing his own expertise in oceanography, hydrology, and sediment transport physics. Advances in the field of environmental geophysics would provide the Institute with greater flexibility in dealing with continued changes to the post-Cold War missions of the various Federal funding agencies. Dr. Mark Dyurgerov was asked to join the Directorate in 1997, from Moscow State University, bringing his expertise on Eurasian glaciology and its impact on sea-level rise. Dr. John Berhendt, a senior scientist with the USGS, joined the Institute as a fellow in 1996. John remains a leading geophysicist working on Antarctic glaciology and volcanology. Dr. Bob Stallard, a federal scientist with the USGS hydrology program, joined the INSTAAR Directorate in 1998, bringing expertise in hydrology and water chemistry. In 1999, Tad Pfeffer joined the Department of Civil, Environmental, and Architectural Engineering as an INSTAAR glaciologist with expertise in snow and ice dynamics. The efforts of these new faces along with the older members of the Glaciology Group (Mark Meier, Ute Herzfeld, Nel Caine) were joined by stellar Research Affiliates from other federal labs and universities: Ned Andrews (hydrology and sediments), David B. Bahr (hydrology and glaciology), Gary Clow (climatology and modeling), Andrew Fountain (glaciology), Pierre Julien (sediment transport and hydrology), John Pitlick (sediment transport and hydro-

drology), Lincoln Pratson (sediment transport and ocean acoustics), and Wesley LeMasurier (Antarctic volcanology). Together this leading group, supported by world class modelers with expertise in the field of mathematics, and engineering physics, have developed the Environmental Computation and Imaging (supercomputer) Facility.

However, along with these changes in personnel and growth, the 1990s witnessed a large turnover in INSTAAR scientists: about third of the 1995 Directorate left by 2001 although the Directorate had increased by 60%. Julie Cole was awarded a faculty position in the CU Department of Geological Sciences in the fall of 1995, but by 2000 she had moved to the University of Arizona, along with her spouse and INSTAAR Fellow Jonathan Overpeck. Professor Mark Meier retired as a faculty member in Department of Geological Sciences in 1998. William Krantz moved to the University of Cincinnati in 2000. Marilyn Walker joined the U.S. Forest Service in Fairbanks, Alaska, and her spouse Skip Walker moved to become a Professor at the University of Alaska in 2000. Fellow Scott Elias moved to join the faculty of the University of London and Fellow Ute Herzfeld moved to University of Trier, Germany, although both remain a fellow-adjoint of the Institute. Tom Stafford left INSTAAR to start his own geochronological business. David Bahr converted his numerical skills to become a software specialist. Dr. Lincoln Pratson, who came to INSTAAR from Lamont-Doherty Geological Observatory in 1996, moved to become a professor at Duke University in 1998. Dr. Eric Steig came from the University of Washington in 1997, but in 1998 joined the faculty of the University of Pennsylvania. Dr. Alexander Wolfe joined the Directorate in 2000 from Queen's University but left in 2001 to join the faculty of the University of Alberta.

Science and News for the 21st Century

The Institute has grown to the point where even listing individual efforts and accomplishments is an enormous undertaking and produce an inordinately large tome. However, certain historical facts help put the late 1990s into perspective. First, this was an incredible post-cold-war period where stock market gains and U.S. prosperity boosted the nation. Second, information technology (IT) spread across the country, wherein a Global Positioning System (GPS) could locate anything with a high degree of accuracy, where the number of space-borne satellites was doubling every few years, and where numerical models were used to fuse satellite data with land-ocean data in what has become known as "data assimilation." Third, communication allowed scientist to reach one another across the globe, quickly and cheaply with the e-mail and internet systems. Together these methods revolutionized how communication was carried out at INSTAAR. For example Dr. Don Cline, a former INSTAAR student, now coordinates a NASA/NOAA/USGS field campaign using the LTER Niwot Ridge site to simulate the temporal and spatial changes to snow cover to better predict stream hydrology. Mort and Joanne Turner have even used satellite images to find ancient Indian quarry sites.

Another major change to INSTAAR during the late 1990s was the rapid increase in Antarctic interest and expertise. Diane McKnight brought along her LTER McMurdo Dry Valleys Antarctic research. John Berhendt continued his airborne geophysical surveys of the Western Antarctic Ice Sheet. Ute Herzfeld analyzed new RadarSat data of the entire Antarctic Ice Sheet. Tad Pfeffer and Eric Steig continued their work on ice sheet history from the long ice core records from Antarctica. John Andrews, Anne Jennings, and students worked on the seafloor

properties off the Ross Ice Shelf. James Syvitski works with colleagues in understanding the sediment dynamics fronting floating ice shelves. Even the Institute journal changed its name to *Arctic, Antarctic, and Alpine Research* and in 1999 was ranked number one geography journal by impact factor (ISI Journal Citations) under the editorship of James Syvitski and Kathleen Salzberg.

Throughout this illustrious period, INSTAAR science made the news almost continuously. In 1995, Mark Meier established the linking between Global Warming, the retreat of small glaciers and subsequent sea-level rise. Mark Williams and student Paul Brooks discovered the extent of microbes living under winter snow cover. John Andrews established how Heinrich (coarse-grained) layers in marine sediment recorded important controls on ocean circulation and climate change.

In 1996, Scott Elias broke news by showing the longevity of the Bering land bridge (still open some 11,000 years ago) and its role in human and animal migration. Additionally he established that the land bridge was then eight to 11°C warmer than today. Bill Bowman determined that Niwot Ridge to be the best understood alpine area in the world by showing how its data could chart global warming, increases in nitrogen pollution (release of nitrates in meltwater), along with increases in precipitation and microbial activity. James Dixon along with Tom Stafford established early man in Alaska at 9,730 years old. James White and Gary Clow made the remarkable discovery that end of the Younger Dryas (11,000 years ago) Greenland air temperatures increased by 10°C in 50 years, establishing the nonlinear nature of climate change.

In 1997, Gifford Miller documented the role that aboriginals played 50,000 years ago in the desertification of Australia, due to their massive burning of indigenous vegetation. He also used amino acid records from

Australian egg shells to record the global cooling between 45,000 and 16,000 years ago. Jonathan Overpeck documented that the warming trend in the Arctic, since 1920, can be tied directly to fossil fuel burning.

In 1998, Connie Woodhouse, along with Robin Webb and Jonathan Overpeck, documented mega-droughts of the Great Plains (as witnessed in the 1930s and 1950s) have occurred with some regularity over the past 400 years. This story was picked up by 40 TV stations, countless newspapers, and radio stations. Astrid Ogilvie broke news with her information on the demise of the Norse colonizers of Greenland (A.D. 985), who had experienced the last six to 12 years of mild weather for many centuries to come. Vera Markgraf made news with by publishing a 15,000-year continuous record of El Niño climate of the Andes, showing that the modern El Niño climate became established 5,000 years ago.

Also in 1998, Tim Seastedt brought to prominence how microbial activity and the nitrogen-cycling of individual plant species appear key agents in the control of alpine ecosystem dynamics, and the acidification of alpine streams. The LTER projected that supported this research continued to employ long- and short-term manipulative experiments and long-term monitoring to study biotic and ecosystem responses and feedbacks to interannual variation in climatic and atmospheric inputs. The site continues to be an essential benchmark for local, regional and national networks that measure ecological phenomena and biological change to human-induced changes in climate and atmospheric chemistry. Along those lines, Bob Stallard provided the first evidence that terrestrial sedimentation (often man-made reservoirs) may account for much of the “missing carbon” in global flux studies. Skip Walker and colleagues defined a regional pH-substrate boundary in the High Arctic dominates the role in gas flux and other

ecosystem properties, rather than soil moisture as previously believed. Skip and Marilyn Walker and Tim Seastedt conducted snow-pack enhancement studies with Niwot Ridge snow fence to test impacts of warming and cooling trends.

In 1998, James Syvitski and student Mark Morehead released a series of INSTAAR hydrological models better able to predict the discharge of remote (ungauged) rivers and the routing of flood waters in both gauged and ungauged basins. Other INSTAAR numerical models are used to increase the extraction of oil from deep sea deposits, and separately by the U.S. Navy to mitigate tactical uncertainty. Mark Dyrugerov documented the role of the 1992 Mt. Pinatubo eruption to have caused to the short-term global storage of 360 km^3 of water as glacial ice, an equivalent to a global sea level lowering of 1 mm. Otherwise INSTAARs established that glacier shrinkage has contributed to 20% of the global sea-level rise in the 20th century. John Berhendt discovered one of the world's largest extinct volcanoes (700 m high, 15 km wide) under the West Antarctic Ice Sheet. Tad Pfeffer clocked the Columbia Glacier in Alaska to be the world's fastest flowing glacier (*Guinness Book of Records*) and elsewhere James Syvitski, Andrew Stein, and John Andrews measured the largest scour of the seafloor by an iceberg, off of East Greenland.

In 1999, John Andrews, Anne Jennings, and student Donald Barber traced the North Atlantic extreme cold temperatures, 8,200 years ago, to the release of ice-dammed lakes spilling from Hudson Bay water into the Atlantic (coldest climate in the last 10,000 years). The implication to global warming is that more meltwater could be released and big freeze developed in our near term future. Julie Cole was one of the first to recover the El Niño record from Pacific coral reefs. Tad Pfeffer sent the alarm that glacier retreat is speeding up in Alaska. Tim Seastedt supported, as an alternative to herbicides used to

combat noxious weeds spreading through the Colorado Front Range, the release of weed-eating insects. Giff Miller discovered that the fires set by Australia's first humans may have also pushed huge animals (megafauna) into extinction. James White and NOAA researchers using stable isotopes of atmospheric carbon dioxide documented the existence of new large sinks of CO_2 in the forests of North America and Asia, suggesting that factors such as climate warming and excess nutrient pollution may cause excess plant growth and, ironically, a slow down in the increase of CO_2 in the atmosphere. This news played greatly in Kyoto protocol and treaty on global CO_2 emission targets.

Outreach and Accolades over the Years

In an effort to bring INSTAAR science to the public, offered its first open house in 1998. Over 500 middle school students and interested public toured the facilities to their great delight. The event became the first in a series of open houses that now includes TV interviews and coverage. INSTAAR also initiated and hosted the first freshmen Summer Undergraduate Research Experience to provide an opportunity for smart high school graduates get a taste of life and research on campus. INSTAAR's Dr. Tom Davinroy continues to run the program.

Mort and Joanne Turner, became recipients of the 1995 H. Marie Wormington Award for their role in getting the Center for the Study of the First Americans up and going. Mark Meier was recipient of the 1996 AGU Horton medal in recognition of outstanding contributions to the geophysical aspects of hydrology. John Berhendt won the 1999 Colorado Book Award for Non-Fiction for his *Innocents on Ice*, which recounts his experiences during the IGY years in Antarctica (1956-57). Misha Plam (director of the MRS 1978-81) was elected in 2001 to the

Russian Academy of Engineering. John Andrews received D.Sc. *honoris causa* from the University of Nottingham, and was elected to the Norwegian Academy of Science. Jonathan Overpeck was recipient of the DoC. Bronze medal. Ute Herzfeld won the IAMG President's award. Nel Caine was recipient of the American Association of Geographers Gilbert Award for excellence in geomorphic research. Mark Williams and other INSTAARs earned the U.S. Environmental Protection Agency Region VIII Outstanding Environmental Achievement Award for their research on land use in the San Miguel River Basin, Colorado.

INSTAARs continued to their world presence in the IGBP-Global Change science. Vera Markgraf chaired IGBP-PAGES Pole-Equator-Pole Paleoclimate of the Americas. Gifford Miller co-chaired IGBP-PAGES CircumArctic PaleoEnvironments program. Marilyn Walker co-chaired the International Tundra Experiment. Robin Webb co-chaired the IGBP-PAGES Paleoenvironmental MultiProxy Analysis program. James Syvitski chaired the IGBP Water-Sediment Global Change Initiative and was on the Scientific Steering Committee for IGBP's Land-Ocean Interaction in the Coastal Zone project.

So INSTAAR has ridden the roller coaster of growth and success. Members continue to touch their past. They have also sharpened their focus on their future. With 300 graduate students, over the last 50 years, INSTAAR has stretched its influence across the U.S. and on to all seven continents. The record is a proud one. And yes, rough periods have come and gone, but the strength and commitment of people who define the institute at any given time remains the underlying pillar of strength.

INSTAAR's Mission for the 21st Century

The Institute of Arctic and Alpine Research strives for excellence in research, education, and societal outreach. The Institute facilitates and accomplishes interdisciplinary studies offering special expertise in high-altitude and high-latitude regions of the world. INSTAAR also offers excellence in global and environmental research including non-cold-region Quaternary studies and geochronology, earth-system dynamics, landscape and seascape evolution, and climate dynamics. INSTAAR aims to understand how the varied regions of the world are affected by natural and human-induced physical and biogeochemical processes on the local, regional, and global scales. Research initiatives are interlinked with our educational and societal outreach missions. By encouraging the use of our facilities, and the expertise of our personnel, INSTAAR provides excellent educational opportunities to graduate and undergraduate students. Our outreach to the wider community, both locally and farther afield, includes aspects of research and education. INSTAAR provides leadership in setting regional, national, and international science priorities and agendas, with particular emphasis on societal-relevant issues.

INSTAAR'S Research Activities integrate field studies, state-of-the art laboratory experiments, field and laboratory data analysis, and numerical and laboratory modeling. INSTAAR emphasizes three themes of research.

The Ecosystems Group focuses on the biological components of alpine and polar systems, global carbon and nitrogen cycling, the dynamics of biodiversity, and ecosystem disturbance and recovery. Long-term Ecological Research (LTER) studies of alpine and polar regions are emphasized, involving populations and communities, biogeochemistry, and ecophysiology. Modern tools include geographic information systems (GIS),

remote sensing, and ecosystem modeling. **The Mountain Research Station** offers a world-class complex of laboratory and field facilities to support these year-round research efforts.

The Geophysics Group applies quantitative field and numerical methods to discover the properties and dynamics of snow, ice, water, and sediments in the world oceans, glaciers, and land areas. Methods of analysis include theoretical and numerical development, remote sensing, and land and ship-borne field experiments, all applied to problems in hydrology, glaciology, frozen ground studies, paleoclimatology, physical oceanography, and marine geology. To facilitate these interests the **Environmental Computation and Imaging Facility** provides researchers with super-computational power and global connections to geophysical databases.

The Past Global Change Group focuses on the reconstruction of the dynamics of paleo environments and past climate variability, to enhance our understanding of the interactions between all components of the earth system, including atmosphere, ocean, land, ice, and the biosphere. Integration of a variety of records from a global network of sites, from the polar ice caps to continental alpine regions and to the world's oceans, provides the capability to test conceptual and predictive global change models, and to facilitate the differentiation between natural and human-induced change. To facilitate these interests the **Center for Geochronological Research (CGR)** provides scientists and state-of-the-art analytical facilities to address the cause, timing, and rates of environmental change in recent Earth history. The CGR fosters synergistic relationships across traditional disciplinary boundaries in order to understand the global circulation system.

INSTAAR'S Teaching Mission is directed towards fostering an appreciation and understanding of the biological, chemical, and physical processes operating in continental and ocean environments. Education efforts are aided by the **Mountain Research Station** and other study sites in the mountains of Colorado. INSTAAR supports the University of Colorado's educational mission and provides interdisciplinary graduate and undergraduate classes and research opportunities. Our teaching mission includes international educational experiences for University of Colorado students, training of foreign students, and volunteer outreach to community schools and various other external constituencies.

INSTAAR'S Societal Mission consists of activities in research, education, and science leadership. These activities address critical concerns involving issues such as ecosystem stability, biodiversity, water resources, agriculture, national security and resources, in sites ranging from the alpine areas of the Rocky Mountains to the remote regions of the world. Our expertise is applied to predictive understanding of environmental processes including the maintenance of water quality, and anticipating and responding to long-term environmental alterations. Changes and disturbance in high-latitude regions not only affect the lives of the indigenous residents, but also have a bearing on the lives of people everywhere, through global teleconnections.



Iceberg off the coast of Laborador. Photo by Anne Jennings.

Memories & Vignettes

John T. Andrews

*Recollections of INSTAAR's Baffin Island/
Eastern Canadian Arctic Research program:
1969–*

OVER THE LAST 30 YEARS ONE of the strengths of the INSTAAR research program has been the “Baffin Island” Program. Many present Quaternary luminaries cut their teeth on the M.A./M.Sc. and Ph.D. theses and dissertations (see list in this publication). The program is still active, although as might be expected there have been shifts in personnel and research foci.

Before I came to the University of Colorado in January 1968, I spent two weeks on Broughton Island in the fall of 1967, supported by my then employer the Geological Survey of Canada. When I came to Boulder my initial idea was to obtain support to work on Quaternary problems in the local area. However, several grants proposals to do such research were turned down, so I resorted to submitting a grant proposal to work on relative sea level and glacial history of the Broughton Island area, northern Cumberland Peninsula, Baffin Island. Because I had actually worked on these topics in Canada, it was easier to convince reviewers that the research was meaningful, accordingly I obtained my first NSF grant from the Earth Sciences Program in 1969. This was the start of a program which attracted a host of exceptionally fine graduate students, many of which continued to work in Quaternary geology after they obtained government or University positions in Canada, the U.S.A., the U.K., and elsewhere.

John England was the first student to work from Broughton Island followed quickly by Giff Miller. John's interests swung to the High Canadian Arctic, but Giff completed his Ph.D. in 1975 and since then has been a faculty-level partner in the program in the late 1970s and early 1980s, developing his own substantial research effort in the area of Frobisher Bay and Cumberland Sound.

During those early years, the University of Colorado had a sufficient presence on Broughton Island that we bought our own house in the village which was named and labelled ‘Colorado House.’ The house sign resides in Giff's office, and I am custodian of the visitor's book.

There are many personal memories of the research in that area. One of the earliest was when Roger Barry and myself obtained funding from the Department of the Army to conduct glaciological and climatological research in the mountains above Quajon Fiord. Because we had military support we were able to persuade the Wyoming National Guard to run a training flight from Buckley Air Field to Frobisher Bay (May 1970). I well remember driving out the Buckley where individuals such as Ray Bradley, Bob Dugdale, Larry Williams, Paul Carrara, and Steve Boyer loaded the plane and roared off. Weeks later Roger Barry and I had a combination of sledging and canoeing with Inuit guides to take us in to the head of Quajon Fiord where we climbed up the headwall to the base camp. The camp had a large sign which said ‘Stoned House’—it took me years to understand the significance of this statement!

The return trip was memorable, i.e. scary. We all congregated in Narpaing Fiord where we had hired a Canso to land on the fiord and transport us to Frobisher Bay and

the National Guard flight home. After what seemed like hours of maneuvering the Canso landed, but not where we were. Thus we had to transport all the people and equipment in a 16-ft. boat out to the Canso—which kept its engines running because the crew was concerned for its safety. In the end, Giff and I took the aluminum boat ashore and then paddled out to the plane in their small, tippy 11-ft canoe. The seas were rough, and getting from the boat into the Canso was a moment I remember with dread. The flight back to Broughton and Frobisher was memorable. First was the ‘attack mode’ adopted by the pilot on a series of large icebergs; then in Broughton Island the fog was rolling in, we had to refuel, but the crew had not brought the felt gas filter. No sweat—Tom Mayberry was wearing of those high-crowned black western hats, it made a perfect filter and we barely made off the airfield.

In 1973 Paul Carrara and I were working between Padle and Kingnait fiords, being moved every so often by helicopter provided by Parks Canada (at that time we had a grant from Parks Canada to undertake a survey for what was to become a National Park). At the same time the camera crew were shooting some James Bond episodes in Pangnirtung Pass with film staff diving off Asgaard. Much to the dismay of Paul and I, who were running out of food, we found on one occasion at least that we were second or third fiddle for helicopter time.

Martha, Melissa (8), and Thomas (3) came with me to Broughton Island in 1975, as did Brian (Professor) Bird of McGill. This led to the infamous episode where the mighty explorer and Arctic survivor (me) casually brought the 24-ft. canoe ashore on rollers. Melissa asked whether it should not be tied up—this suggestion was dismissed as being inappropriate advice from an 8-year-old, but ... a few minutes later a gust of wind gently rolled the boat back on the rollers into Kivitoo Bay. The radio was working poorly, but we

had food for several weeks. In a few days a group of archaeologists showed up, and Brian then told them to go back up into Quajon and look for the canoe. Lo and behold, after an hour or so they returned with the canoe and motor. The sorry story of my errors did not stop there however, because on the next trip down into Canso Channel I forgot the tent posts. Luckily drift-wood came to the rescue.

The field program on Broughton Island came to end around 1980 or so, and the house was sold. At that point I was to transfer my research interests to marine Quaternary matters, starting with Lisa Osterman and then Anne Jennings, and the Baffin Program was now mainly being run by Giff Miller. Research cruises along the Baffin Island margin involved INSTAAR graduate students and faculty in 1983, 1984, 1985, 1990, and 1992. This eventually led into such research topics as the chronology, source, and paleoceanography of the North Atlantic Heinrich events.

The last time I set foot on my favorite island was in 1987 when Jay Stravers, Giff, and I led an INQUA field trip to Frobisher Bay. George Denton and Jonathan Overpeck were two of the participants in what was a memorable trip.

The research on Baffin Island in many ways continued significantly to the University of Colorado’s reputation in Quaternary geology and issues of Past Global Change. The alumni of this program are many, and many but not all, continue research on Baffin Island or in Arctic areas. The data and ideas generated from this research were one principal side of the 1980s argument of ‘big’ versus ‘little’ ice. This topic is still of importance and interest, but the margins have shifted seaward of where they were placed in the 1980s but still not to the shelf break. Much remains to be done and experienced.

John T. Andrews

INSTAAR's Nordic (Norwegian and Icelandic) connections

OVER THE YEARS, INSTAAR has established close research and personalities with a variety of organizations and countries. There is for example a very strong and lasting connection with Norwegian researchers at the University of Bergen, started with Jan Mangerud and many colleagues and students, and the University of Tromsø with Tore Vorren and Morten Hald. In return many INSTAARs have travelled to Norway for post-doc and graduate studies including such alumni as Giff Miller, Scott Lehman, Julie Brigham-Grette. For many years Giff Miller and his graduates ran a successful research program on Svalbard. Jan Mangerud, Jon Landvik, Ida Lønne, Morten Hald, Tore Vorren, among others have reciprocated much to our delight and benefit. Starbucks, at 30th and Arapahoe, has benefitted greatly from the exchange! The interactions have resulted in joint research efforts, including a 1996 cruise on the Jan Mayen with Morten Hald and Anne Jennings sharing leadership of the cruise research. This cruise has led to several theses on both sides of the Atlantic and continued co-operation between the University of Tromsø and the University of Colorado. Jan Mangerud must be thanked for initiating this most enjoyable and productive exchange between Norway and INSTAAR.

The INSTAAR Iceland connection started in the mid 1980s when Aslaug Geirsdottir arrived in Boulder for a Ph.D. degree. Her dissertation (1989) involved a study of the origins of diamictons in some of the Pliocene sections in southwest Iceland and the history of glaciation in Iceland. She was added to at the directorate level when Astrid Ogilvie moved to Boulder from her former position at the Climate Research Center at

the University of East Anglia, England.

Astrid had been undertaking research in Iceland over the past 25 years. She has close collaborative connections with colleagues at the University of Iceland and the Icelandic Meteorological Office, with whom she has written papers and recently edited a book.

Meanwhile, other connections were developed with the Marine Research Institute (MRI) in Reykjavik, whose ship was used (*Bjarni Saemundsson*) on INSTAAR cruises to the east Greenland margin in 1988 (Kersten Williams) and 1991 (John Andrews). This resulted in joint research between Anne Jennings and Gudrun Helgadóttir (MRI). Additional research on the Iceland margin was accomplished in 1993 from CSS *Hudson's* part of a large-scale cruise into Icelandic and Greenland waters. The chief scientist on the cruise was James Syvitksi who went on to become director of INSTAAR. Cooperative research between Icelandic institutions and INSTAAR commenced in 1996 when we were awarded an NSF grant for work on lake and marine sediment cores on and around Iceland. Jorunn Hardardóttir was dispatched from Iceland to undertake her Ph.D. dissertation at Colorado, while Aslaug Geirsdottir spearheaded the lake coring project and Gudrun Helgadóttir arranged for two weeks of ship time in 1997 on the *Bjarni Saemundsson* (cruise B997). Thus in July 1997, MRI, University of Iceland, and INSTAAR had a most productive cruise around the margin of west and north Iceland, occupying some 40 stations and retrieving over 100 sediment cores. Based on this cruise, several theses and dissertations have been produced at the University of Colorado and the University of Iceland, including Mikie Smith (Ph.D. 2001), Isla Castaneda (M.Sc. 2001), Greta Kristjansdóttir (M.Sc., Iceland 1999; enrolled Ph.D. student at Colorado 2000–), Sarah Principato (Ph.D., 1999–), and Eric James (B.A., Honors). Inga Jonsdóttir (Ph.D. Cambridge University) also visited

INSTAAR as she and Astrid Ogilvie continue their work on historical documents pertaining to sea-ice and climate of Iceland. Astrid has worked for many years on reconstructing the climate and sea-ice history of Iceland with particular focus on the last thousand years. She has also researched fisheries and land-use history in Iceland, concentrating on the human dimensions of climate and environmental change in the North Atlantic region, including early settlement history of the Viking era and the loss of the Norse settlement in Greenland. At INSTAAR Astrid, along with John Andrews and Lisa Barlow, has worked on these topics and they have integrated different proxy records of environmental change.

Marine research continued in 1999 when INSTAAR staff and students and our Icelandic colleagues joined the French research vessel *Marion Dufresne* in Iceland for leg three of an international IMAGES cruise. Field research has started (2000) on the Northwest Iceland Peninsula (Sarah Principato) and in 2001 Sarah, John Andrews, and Aslaug Geirsdottir will continue the joint Iceland/INSTAAR efforts. Gudrun Helgadóttir spent research time at INSTAAR in the fall of 1999, and Aslaug has just completed a half-year sabbatical (2001).

Julie Brigham-Grette

■ WAS A RESIDENT GRADUATE STUDENT at INSTAAR for both my master's and Ph.D. from 1977 to 1983. Probably like most graduate experiences, this was a life-changing period for me. I entered graduate school with the goal of obtaining a master's degree before returning to a fledgling career in the National Park Service. But what transpired was the realization that I enjoyed the challenge of research, the satisfaction of discovery and the camaraderie of other scientists. I am not sure what drew me to the Arctic and, to be per-

fectly honest, before coming to INSTAAR I had never heard of John Andrews. But certainly INSTAAR was the *best* place to be mentored in arctic research. All of us have read the accounts of early arctic explorers and poorly known scientists who either described the arctic floras and faunas for the first time, sought mineral wealth, the conquest of land, or elusive trade routes through the arctic sea ice. They met hardships to make observations and accomplish their goals just as we sometimes do despite our high tech gear. In fact, even today we realize that we all have a great deal in common with them. After all, what drives someone to sit huddled taking field notes collecting fossils day after day in a cold wind on the arctic coast? What motivates someone to persist by boat to a destination on an obscure map through miles of sea ice? At INSTAAR I was surrounded by colleagues who shared that same spirit and was inspired by professors who taught the scientific endeavor by example in all its dimensions. The transcripts show what courses we took at INSTAAR but there is so much more to what we all learned there!

I have many cherished memories of daily life at INSTAAR. I remember in the late 1970s John Andrews would walk the halls in his clogs (we all knew the tempo of his gait by the sound in the hallway) and visit each graduate student at his/her desk. On a weekly basis he would sit down and discuss progress with each student. These were not scheduled events; rather, John would just walk in to a grad office and it would happen. Since we all knew John did this, an underculture developed among the students to always leave work in progress smeared all over your desk, just in case he came by. As a young master's student I was told to do this by one of the older students. None of us wanted John to think we weren't working hard so it was important not to have a clean desk. It was almost like playing a joke on him—yet we also knew that we needed (wanted?) to work as hard as he did.

One of my other favorite memories is of lunch times in the amino acid lab. Commonly Giff Miller, John Andrews, and a few the grad students would share lunch at the table and toss around ideas. John Hollin was always sure to show up with a copy of *Science* in hand to ask if we had seen something in the latest issue. The open door policy held by most at INSTAAR meant that ideas flowed and we all shared in the academic adventure. I still strive to reconstruct that culture among my own students.

John Clark

A wild ride on Niwot Ridge

ON A WEATHER STATION maintenance trip to D-1 Station I drove an M29 Weasel snowcat off the south side of Niwot Ridge into the Boulder Watershed. I was driving in a blowing snow white out and became disoriented, thinking I was traveling west when I was actually going south.

On the morning of a spring day in early May 1957, I set out from the Mountain Research Station to service the 12,300 foot weather station, called D-1, on Niwot Ridge. I was accompanied by an undergraduate student named Margaret Powers. We drove through the subalpine forest through deep, fresh snow toward timberline following the Albion Road route. From timberline I took a direct route to the promontory known as the East Knoll. There was an unusually deep and total snow cover over the tundra at the time, so deep as to cover the Boulder Watershed boundary fence which ordinarily served as a route guide to the area west of the East Knoll. We encountered ground blizzard conditions at the East Knoll but I was able to make out the next landmark on the route to D-1, the West Knoll to the west about a half mile distant. At the West Knoll I took a compass bearing to orient myself to a line directly west and proceeded to drive forward,

very slowly. The ground blizzard became a total white out so that it was necessary for me to concentrate on observing the surface beside and directly in front of the snow cat, hoping to recognize rock outcroppings which I knew were several hundred yards west of the West Knoll and I hoped would be showing out of the deep snow blanketing the ridge. I never realized that the vehicle slowly turned left toward the south and headed directly for the cliffs on the south-facing slope of the Green Lakes valley. Ordinarily I would have been stopped by the watershed fence running east and west, but it was covered by the deep snow.

The first indication of trouble was the sound of the engine revving at high RPM without any sensation of increased speed. Then there was a sensation in my stomach of falling. Immediately, the whiteout cleared and I saw to my horror that I was heading down a steep couloir between rock outcroppings to the right and left. I pulled back on the steering brake levers as hard as I could, I believed our lives depended on stopping the vehicle before it turned over and began rolling down the couloir. Next we struck a small outcropping of rock with the left track and the Weasel turned sideways on the slope (I thought for sure it would roll over), then turned back headed directly down, skidded along a few more yards and stopped! I called to Margaret to get out and move away from the vehicle. To my joy, the little snow cat stayed perched on the steep slope when I gradually released the brake levers, leaving the transmission in gear; the engine was stopped. I pulled the levers back again and asked Margaret to come over and get our packs and snow shoes out of the back and I exited the vehicle. The slope was so steep it was difficult to stand and the snow was so hard one needed to be careful not to slide away. We had stopped about 200 yards from the bottom of the couloir after descending about 50 yards. We had gone over a small

cornice and landed in the couloir directly in the “fall line” for a perfect line of descent. I discovered the left track had been knocked out of line with the suspension “bogie” wheels and jammed against the hull of the vehicle, preventing it from turning. This good fortune had stopped the vehicle and may have saved our lives.

We traversed off the steep snow slope and proceeded to snow shoe back to the MRS, some four miles distant. In retrospect, I can see several operational errors on my part. First, I should have aborted the mission when I saw such ground blizzard conditions at the East Knoll; and second, I definitely should have turned around when I encountered the white out at the West Knoll. The crew who recovered the Weasel measured the angle of the snow slope we descended as fifty-six degrees, approximately the angle of the Boulder “Flatirons.”

Scott Elias

DURING THE LAST 25 YEARS, it has my privilege to work with a particular group of very talented, hard-working scientists at INSTAAR. They put in the same long hours as everyone else, wrote at least as many grant proposals, and generally did their part to keep things humming along in the institute, but they had one thing else in common, they lived on soft money. In other words, the university allowed them to work there, as long as they raised all their own salary from outside sources. In the American academic system, it seems that all major research universities have large numbers of these people, doing a big share of the work, and getting little or no official credit or support. Actually, INSTAAR has treated her soft-money people far more fairly than other places, giving them voting rights within the institute. As a soft-money colleague at Ohio State once told me, ‘If you ain’t hard money

around here, you’re dog crap.’ But no matter how fair the treatment, they have always been the unsung heroes, the Rodney Dangerfields of the scientific profession. Some of them would not have taken a hard-money (= tenure track) position at CU, even if it had been offered them. They actually preferred the free-lance life style, with no teaching commitments, no graduate student supervision, and no departmental duties to perform outside INSTAAR. Of course every person’s reasons for taking this kind of position are different. Some have had spouses with reliable incomes, so they could afford to indulge their interests in scientific work without having to worry about next month’s mortgage payment. Others kept the wolf from the door by filling in with a bit of free-lance writing, leading field courses, training park rangers in science, driving a cab, or doing night shift factory work. Here are a few reminiscences about my personal friends who went down the soft money trail in INSTAAR over the years.

One of the best friends I made in INSTAAR was James Halfpenny. Jim is a mammalogist, field ecologist, expert animal tracker, and one of the most able all-rounders I have ever known. He would have made the perfect natural historian to send on the Hayden expedition to the Yellowstone region, back in the late 1860s. He could have identified all the animal life, most of the native plants, kept the party abreast of celestial events in the night sky, and entertained them with tall tales over the camp fire. The man simply loves to study nature. Who else would set live traps in a research trailer at night, to find out which species of mice were eating our food? Unfortunately, natural history has fallen out of favor as a branch of science during the last 20–30 years, and the system eventually squeezed Jim out.

Jim and I worked closely together on an NSF-funded project designed to improve our understanding of packrat behavior in the Chihuahuan Desert regions of Texas and

New Mexico. Packrats, also called woodrats, are the dominant group of native rats of North America, and fossil plants and insect remains sampled from ancient packrat nests are one of the most important source of proxy data for Pleistocene paleoclimates of deserts on this continent. Since the rats collect the plants, we wanted to learn more about their foraging habits. One thing I learned about Jim during this project is that he is an incessant note-taker. He was always whipping out his little field notebook, and scribbling a few lines in it before going on to the next task. This seems perfectly normal when you are on the job, but I soon found out that Jim was never 'off the job' when he was in the field. For a while, we worked out of a cabin in the hills near Alpine, Texas. He loaned me his notes one day, so that I could copy some data, and I ran across a series of nightly entries that ran something along these lines:

"Wednesday, November 12, 0100 hours: Mephitis mephitis visited cabin, scratched around foundations until 0108 hours, then departed."

"Thursday, November 13, 0240 hours: same individual (?) of Mephitis mephitis approached cabin, scratched at door until 0250 hours, then departed."

The man was keeping track of nightly skunk visits, logging them in as if they were vital to the project. The last 'skunk' entry ran along these lines:

"Friday, November 14, 0300 hours: Same Mephitis mephitis visited cabin, but had nothing to report, and so departed."

Later on that same trip, we managed to catch ourselves a skunk in a live trap. On our daily outing to check the traps for packrats, Jim called me over to see a particularly interesting specimen of large, angry, black-and-white variety rat (he was not above pulling my leg frequently, so took my time coming over to the trap). There was a spotted skunk, hiss-

ing and stamping his feet, with blood in his eye and a particular message he wanted to deliver to his captors. Needless to say, we took a great deal of time and care in liberating this animal, and managed to accomplish it without getting sprayed.

Another good friend made at INSTAAR was Thomas Stafford, Jr. Tom, like Jim Halfpenny, is the kind of person about whom it is said, "I've never met anybody like him." Tom is a vertebrate paleontologist, geochemist, and especially a radiocarbon dating expert, who specializes in extracting organic molecules from ancient bones. He was brought into INSTAAR's Center for Geochronology to set up and operate a laboratory dedicated to the preparation of samples (graphite targets) to be radiocarbon-dated in an accelerator mass spectrometer facility, such as they have at the University of Arizona, in Tucson, and the Lawrence-Livermore Laboratory in California. The man has a passion for perfecting his laboratory methods and upgrading his lab hardware. It paid off in the form of more work than he could handle, arriving as ancient bones from archaeologists and paleoecologists from around the world. They found out that he could tease a reliable radiocarbon age out of the proverbial gnat's eyebrow. He did it by building the most thoroughly clean, thoroughly automated chemical preparation line ever designed for the painstaking task of extracting ancient bits of protein from fossil bones. Tom was constantly calling me over to his lab to show me the latest refinements. When the normal Pyrex[®] glassware tubing did not seem to be giving good enough results, he scrapped the whole set-up and switched over to stainless steel tubing. When even that was not good enough, he found a source of precision-drilled stainless steel tubes that would trap virtually no particles. These came from the dairy industry, which has to worry about bacteria hiding out in their milk production plants during the pasteurization process. Then he designed a computer pro-

gram that robotically controlled his collection of little pumps, motors, heaters, and other gizmos, all installed in the chemical lines to automate the chemical reaction sequence. Tom let me know that no human hands have the mechanical reliability to run his sample preparation scheme with the same exact motions, over and over, through the night if need be, to get the job done. Is it any wonder that the man was able to get a radiocarbon age out of the fossil proteins extracted from a single shrew's mandible?

These fellow travelers in soft money science, as well as others, such as Susan Short, Kirsten Williams, Vera Markgraf, and Anne Jennings, made life around INSTAAR much more interesting for me. We formed many good friendships as we struggled down that rocky road, working for recognition within the university, patting each other on the back when the grants came in, offering a sympathetic ear when the grants were turned down. Some have moved on to other jobs, others remain. I will always cherish their friendship.

Jim Erdman

John Marr's Teaching Style

I BEGAN MY GRADUATE SCHOOL at CU the fall of 1958, having left North Central College, Naperville, Illinois, the prior spring with a degree in zoology. I'd been in a premed program for most of those four years, but my nemesis was organic chemistry. (Ironically, I later joined the branch of geochemistry with the U.S. Geological Survey, eventually becoming a biogeochemist!) My senior year I took a course in field biology that used a simple textbook entitled *Reading the Landscape* that thrust me on a completely new tack. In those days "ecology" was hardly a household word; few people knew what it meant, fewer how to pronounce it. Degrees in ecology were limited to only a few universities, the University of

Colorado being one. Two basic courses in ecology, Dr. Marr's "General Plant Ecology" and Dr. Pennak's "General Animal Ecology," were to be pivotal. The contrast in teaching styles could not have been more extreme. Marr's approach was experiential; we never cracked a book for it seemed a month that early fall of 1958, but spent time out near Marshall Mesa observing and trying to interpret what we saw. Dr. Pennak—having published THE bible on Freshwater Limnology—was god. He lectured, and lectured. I remember approaching him after my poor performance on my first exam. He simply said "You're a graduate student, no?" (this was a 400-level course, for upper-level undergraduates also). End of discussion. I later learned that one merely had to memorize his lecture notes and learn to define all the italicized words in the text to do well. To me, rote memorization of facts is hardly the approach to gaining wisdom! (I published a Letter to the Editor in *The Denver Post* late last year that underscored our educational system's misguided efforts for students to pass proficiency tests, creating a generation of "mindless robots.") So, based solely on that experience, I switched my major, picked up some deficiencies in botany, and was off on even another tack. Since that pivotal early autumn of 1958, Dr. Marr instilled in me a passion to "read the landscape." And for four decades I've never looked back, fascinated with analyzing a myriad of terrains that have included the deserts of Sonora, Mexico, Arizona, and New Mexico; the entire state of Missouri; the high plains and sagebrush "ocean" of the West; Alaska and its central Aleutian Islands. Overseas conferences took me to Sweden, Finland, Germany, and China, including its "outback," Inner Mongolia. Loving every minute. Rubbing shoulders with geologic mappers, geophysicists, geochemists, and remote sensors, I integrated that knowledge and understanding gained into my work in environmental biogeochem-

istry and geobotany, and mineral and geothermal exploration.

John Marr's Field Style

SUMMER, 1959. Wetherill Mesa, Mesa Verde National Park. Dr. Douglas Osborne, supervisory archeologist for the Wetherill Mesa Archeological Project, had contacted Dr. Marr to find a graduate student who might serve on the project as its plant ecologist. I'd been considering a study of aspen near Science Lodge for my master's thesis. Not knowing what I was getting into, I certainly liked the idea of being funded by the National Geographic Society to conduct some of the ancillary studies supported by the society. What a challenging, interdisciplinary effort. (Initially, though, I was hired as a "laborer" at \$1.99/hour.) I recall a visit that summer by John Marr and Colorado's flora authority, Bill Weber, with the intent to design a workable thesis project. (I'd worked both as field assistant of INSTAAR and as herbarium assistant under Dr. Weber.) We'd hiked down the trail from Spruce Tree Canyon over to Navajo Canyon. And, as I scrambled up the talus slopes (by then I was thin as a rail from walking over mesas and through canyons for weeks), I still can see Dr. Marr with pipe in hand stepping slowly up the bouldery terrain. Thinking, observing.

INSTAAR also was to install six weather stations, three along a transect from the southern end of Chapin Mesa on the Ute Mountain Ute Reservation to the North Rim, and three in Navajo Canyon to the west of Chapin Mesa. The intent, to not only measure the variability of the microclimate for its own sake (Erdman, Douglas, and Marr, 1969, *Environment of Mesa Verde, Colorado, Wetherill Mesa Studies: National Park Service Archeological Research Series Number 7-B*), but to aid in dendroclimatological research conducted by the first dendroclimatologist in this country, Hal

Fritts, who'd just received his doctorate and joined the staff of the Tree-Ring Laboratory, University of Arizona, Tucson. We installed Fritts dendrographs on trees at each of the weather-station sites, which I serviced along with the the weather instruments over the several years I worked and lived at Mesa Verde. The dendroclimatological results (Fritts, Smith, and Stokes, 1965, *The biological model for paleoclimatic interpretation of Mesa Verde tree-ring series: Memoirs of the Society for American Archaeology*, no. 19; *American Antiquity*, vol. 31, no. 2, pt. 2) shed a new perspective on cycles of drought during the prehistoric occupation. My descriptive studies of the pinyon-juniper woodland provided the basis for a master's thesis (Erdman, J. A., 1962, *Ecology of the pinyon-juniper woodland of Wetherill Mesa, Mesa Verde National Park, Colorado: M.A. thesis*). They also were the basis, in part, for my publishing an annotated list of the plants of Mesa Verde in collaboration with Stan Welsh of Brigham Young University, with whom I helped identify the vegetal remains from the excavations of the early Pueblo ruins (Welsh and Erdman, 1964, "Annotated checklist of the plants of Mesa Verde, Colorado": *Brigham Young University Science Bulletin, Biological Series*—vol. 4, no. 2). My doctoral work clearly grew out of my experience on the fire lines of the 2,043-acre Morfield Burn that summer of 1959. By gaining familiarity with the dendrochronological cross-dating technique, I was able to include a burn from 1873. My doctoral thesis was published as a *Brigham Young University's Science Bulletin* (Erdman, James A., 1970, *Pinyon-juniper succession after natural fires on residual soils of Mesa Verde, Colorado: Brigham Young University Science Bulletin, Biological Series*, vol. 11, no. 2). Those years surrounded by the mystery of the Anasazi were the best of our lives—my wife, my two (then) young sons, and me—thanks to John Marr!

Franklin Folsom

Life Before INSTAAR—Some Recollections of University Camp

ABOUT 1922 WHEN I WAS 15, I was hired by the Recreation Department of the University to be a camp helper at University Camp. I had to get up early in the morning, sometimes about 4 A.M., to start the fires in the cookstove. I had to split stave wood, peel potatoes and be a helper around the kitchen, and I had to wash dishes. The volume of dishes varied greatly from day to day, depending on the size of the parties that came into camp. One day the Chamber of Commerce organized a huge hike up Arapaho. The hikers were bused from University Camp to Rainbow Lakes. From there they hiked up over Baldy to the Saddle and South Peak. The crowd was large, and it was followed during the day by other smaller groups that came on different missions. The result was that I washed dishes from 4 A.M. until midnight. This experience doubtless had something to do with my decision to follow some line of work other than dishwashing for my career.

Occasionally the work in the kitchen was finished by the time hikers were ready to leave camp and I was allowed to go along on the hikes and help some of the weaker hikers. In this way I became acquainted with the area at a time when hiking was permitted in the Silver Lake drainage and up over the moraine.

I increased my knowledge of the area in the summer of 1923(?) when I worked in the Geology Camp adjoining University Camp. With others I went up before the camp opened up and helped clean up the big cabin where the students took their meals. To our astonishment, none of the knives, forks and spoons were where they had been left the preceding fall. We found most of the small utensils up the second floor in pack rat nests. The place had been taken over by the crit-

ters. I remember battling with one using a piece of stove wood as a weapon. I won the battle, but I did not relish my victory when I beheld the bloody mess I had made in one of the cupboards in the kitchen.

In Geology Camp my immediate boss was Frances "Peg" Thompson, daughter of "Pop" Thompson who had established the first University Camp closer to Silver Lake. Supervising Peg, who did the actual cooking, was Mrs. McCourt, wife of Dean McCourt, director of the Geology Camp. Mrs. McCourt would come into the kitchen and complain because the canned goods stored on open shelves there were not arranged in a pattern that was "artistic and symmetrical." Dean McCourt was an inveterate cigar smoker, but on a hike he never smoked until noon. He said smoking cut his wind on uphill climbs.

McCourt led hikes all over the area and I was allowed to go along. Also, I attended all the lectures at night around the campfire, and before I left high school I had picked up as much knowledge of geology as most college students get from an introductory geology course.

The summer school, students who enrolled in this field geology course lived in tents near Geology Lodge. They were a varied lot. One man I recall had been a violinist with the Prague Symphony Orchestra, and he used to play for the crowd around the campfire. As I washed dishes at Geology Camp and at University Camp I had to deal with the fact that gallon containers of jam were stored under the kitchen sink. My way of coping with this situation was to help myself liberally to huge quantities of the lovely sweet stuff. I am not sure that I was ever reprimanded, or even caught, but I did suffer for my excesses. I had not only the usual adolescent acne. I had outbreaks of boils, that doctors said were aided in their vigorous development by my diet of jam.

My knowledge of the area got me a promotion from camp helper to assistant guide. For several summers when I was in college I helped to guide Recreation Department parties. Sometimes they went up to Arapaho over Baldy, sometimes they went up Fourth of July Canyon. We also climbed Navajo, Albion, Audubon and other points among the Indian peaks. Also we took trips up Long's, but we were not based at University Camp for these expeditions.

The head guides were Harry Vars and Emory(?) Nussbaum. Harry became an eminent scientist and professor at the University of Pennsylvania Medical School. Warren Gilbert was an assistant guide with me as was his sister Rachel. Warren became a physician who practiced in Rome, Georgia.

Charles Hutchinson, professor in the Engineering School, was recreation director during one or two of the summers when I guided, and A. Gayle Waldrop, a teacher in the Journalism Department was in charge during other summers. Waldrop was so deeply attached to University Camp that when he married the artist Gwendolyn Meux they arranged to have the wedding at the camp, outdoors. They sent out invitations for the wedding beautifully lettered by Gwen on sheets of aspen bark.

The first year I worked at University Camp horses were used there in connection with construction work. I was a city boy from the huge metropolis of Boulder (population 10,000) and I knew nothing about horses, but for some reason I was asked one morning to harness a team. I never got a second request to do this job. I had put the horse collars on upside down and one of the horses ran away. When the frightened animal stopped running and put its head down to nibble something the horse collar fell forward bashing his head and of course frightening him and stirring him up to run off wildly again.

On one trip from University Camp to Arapaho via Rainbow Lakes we had about a hundred hikers. At the saddle the party divided. Warren Gilbert took half of the people back over Baldy to Rainbow Lakes. I with Rachel Gilbert as an assistant took the other half of the party up over the South Peak and on to the North Peak of Arapaho. On the ridge between the south and north peaks a Miss Stonebreaker sprained her ankle. The distance was just as far back to help as it was forward, so we kept on going to North Peak. From there the route down went over what we called Henderson Glacier and on down to Silver Lake where busses would meet us. At the top of Henderson Glacier I got a big husky fellow to help the hikers scramble down onto the snow. I planned to have the hikers slide down Henderson Glacier (which I've since learned is not a true glacier). Before we got well started the big fellow gave a yelp and ran, slid and tumbled down the big snowbank. I had to find out what was wrong with him. Leaving the party Rachel's charge I slid down the snowbank standing up ski fashion. At the bottom I found the big fellow sitting in the snow and sobbing. By way of explanation he took off his hat which was a kind of hard hat, and put my finger on his scalp. There was a soft place there—no bone. At the top of the snow bank a hiker had kicked loose a small rock that had struck his hard hat. The vibrations had reached his brain and disoriented him. He didn't really know what he had done. It seemed to me that he was in no immediate danger. I got him on the rocks, climbed up to the top of the snowbank and directed the hikers how best to slide down sitting in the snow. Then I had the problem of getting Miss Stonebreaker down. I sat her down and sat in front of her with her legs around me. I held the injured leg up above the snow. Then down we went with Miss Stonebreaker's oilskin raincoat doing excellent service as a sled. At one point Miss Stonebreaker got frightened, kicked her good leg into the snow, and we

pivoted around. Now we were going head first, face up, speeding along with only my heels and elbows serving as brakes. Just when Miss Stonebreaker was due to crash into the rocks at the bottom Warren Gilbert dove into us and saved our lives, or at least saved the life of Miss Stonebreaker.

Warren had taken his party back to the camp, then, realizing that we were very late, had hiked up from Silver Lake and arrived just in time to dash out onto the snow and grab us before we came to disaster.

With Warren's help we got Miss Stonebreaker down to Silver Lake and the buses, and there we were cheered on by Mr. Dolly, the Boulder water supply caretaker who lived in the cabin at the lake. He was lonely there and for company he had papered the walls and the ceiling of the cabin with photos of pin-up girls. These did not prove adequate to his needs and he advertised in a lonely hearts column in a pulp magazine for a wife. He got one and she came to Silver Lake and moved into the cabin. But during her first winter there she decided for some reason to run away. She set out for Nederland, but never arrived. Not until next spring did anyone find a trace of her. Then someone found her frozen body clad only in a house dress. She had got only part way to town.

Mr. Dolly soon sought other employment and was replaced as a caretaker by a Mr. Dally.

Scandals at University Camp? There were one or two but I'll leave it to the principals to report their dalliances if they want to.

If you are interested in what effect life in University Camp and Geology Camp had on one teenager, I can report that imagery from the area turned up many years later in books written for, young readers. I did a series of mystery adventure novels published by Whitman of Racine, Wisconsin, and distributed in the dime stores. Several of these yarns drew heavily on events that occurred in the beautiful area where scientists now conduct scientific research.

David M. Gates

Memoir I

I SHALL NEVER FORGET my first image of John Marr and the Institute. I have an undated, yellowed newspaper clipping "Science Lodge High in the Mountains Scene of Arctic and Alpine Research." I was a young assistant professor of physics at the University of Denver and absolutely green with envy, never dreaming I would ever be associated with it. At DU we had a cosmic ray laboratory on Mount Evans. I did solar and atmospheric research there. I thought that DU should have a mountain lab for physics, physiology, and ecology. In 1957 I became assistant chief of the upper atmosphere and space physics division of the National Bureau of Standards in Boulder. I met John Marr, we hit it off immediately, and I told John my ideas for making ecology more analytical. Donald Lawrence, Marr's thesis adviser, had asked me to give a series of lectures at the University of Minnesota which resulted in my first book, *Energy Exchange in the Biosphere*. This plus John's influence propelled me into biology from physics.

John, along with Hugo Rodeck, engineered for me the position of tenured professor of natural history, curator of ecology with the Museum, research at the Institute, and teaching in biology, all approved by the Board of Regents Sept. 11, 1964. I moved from NBS to the university in January 1965. Then a startling and totally unexpected event happened. I was offered the directorship of the Missouri Botanical Garden and a professorship of botany at Washington University. The hardest thing I ever did was to tell John Marr I was leaving. He had wished for me to take over as director of INSTAAR when he retired. I loved Boulder, the university, INSTAAR, and the mountains, but the new opportunity was great.

The rest is history. After six years in Saint Louis I returned to my roots at the University of Michigan in 1971 as director of the

Biological Station on Douglas Lake where my father, Frank C. Gates, had taught plant ecology from 1915 through 1954. His first summer there was 1911. But the best break of good fortune I ever had started at INSTAAR when I met Mark Paddock and he accompanied me to Saint Louis, Ann Arbor and Douglas Lake during which time he did all the work and I had all the fun.

Memoir II

A TRULY MEMORABLE EVENT in September 1962 was the visit to Science Lodge of Sir Vivian Fuchs, the British Antarctic explorer who led the historic 1957–58 trans-Antarctic Expedition across the continent from the Filchner Ice Shelf to McMurdo Sound; Paule Siple, the Antarctic leader of West Base at Little America III in 1940, who had been to Antarctica with Admiral Byrd in 1928 as a boy scout, who is best remembered for his establishment of a wind chill chart, and for whom Siple Station is named; and Louis Quam, a Colorado native, geographer, and former CU professor, who now was head of the geography branch in NSF. I brought my son Murray along on this little excursion with John Marr showing them the lodge and climatological stations up Niwot Ridge.

In the year or so before I left Boulder John was collaborating with the chief archaeologist at Mesa Verde, Douglas Osborne, to add some ecological-climatological understanding to the interpretation as to why the pueblos were abandoned in the late 13th century. Osborne had a passion for Charlie Chaplin and Our Gang movies. I had the great pleasure to participate with John in some of these visits to Mesa Verde. I shall never forget one superb evening when a group of us were seated on the edge of the canyon at Wetherill Mesa. We were near the top of the west facing wall heated by the setting sun and experiencing a dramatic flow of hot air out of the canyon, al-

most a firestorm rush, as heavier cooler air sunk into the canyon from the east facing, shaded wall across the way.

John was an excellent fly fisherman as he effectively demonstrated one evening along either the Los Piños or Piedra River east of Durango after one of our Mesa Verde excursions. However, there was another time. Friday, 18 September 1964, Richard Waugh, Joe Ruwitch, John, and I headed to the Laramie River in a heavy downpour arriving at their rented cottage after dark. In the morning the Laramie was muddy and swollen, lousy fly fishing. We crossed over to the Michigan and North Platte rivers where the fishing was not much better, but Dick Waugh snagged one trout and clumsy me caught two, while John and Joe were skunked. It wasn't the most successful weekend except for the camaraderie, which was superb.

Joyce Gellhorn

I AM REMINDED OF A STORY told by my mentor, Dr. John Marr, who founded the Institute of Arctic and Alpine Research at the University of Colorado. His class observed the krummholz, the stunted, wind-blown, shrub-like trees above timberline. Drifts covered these small islands of trees located at the lower edge of the alpine tundra; only a few branches reached above the snow cover. Marr was explaining that severe winds laden with ice crystals pruned the windward sides of the tree islands, shaping them asymmetrically. As he spoke, a ptarmigan walked from one krummholz to another, methodically plucking buds. Astounded, Marr admitted he had never seen a ptarmigan eating spruce buds before, "wind-trimming" his krummholz. He conceded that factors other than wind might also contribute to ecosystem dynamics. Marr loved this story and retold it many times to illustrate the importance of being aware of the total environ-

ment. He always emphasized that being in the field one could see more than quantities being measured by instruments, and stressed field research must be done during all times of the year, not just during the summer. To teach ecology without field studies, he said, is like standing in front of a diorama in the Denver Museum of Natural History with the shade pulled down and describing to students what's behind the shade.

The dynamics of winter are especially important, Marr emphasized. Winter influences activities of organisms and ecological processes during all times of the year. Shortly before his death in 1989, I visited John Marr and we talked of Niwot Ridge, the weather stations, and the Institute of Arctic and Alpine Research. I asked, "John, what season do you like most in the alpine?" Though very ill, his face lit up and without hesitation he answered, "Winter, because it's so dynamic!"

Skip Greene

ALWAYS COUPLED TO and mixed in with all my many vivid memories from the Mountain Research Station where I was the first year-round live-in manager, is a key memory that I will always cherish and honor. That memory is how Dr. John Marr viewed and used the concept of working with everything in life, be it studies or plowing the station road, from the position of always being a student. Tied irrevocably to that concept was his view that students of all kinds should be given a free hand to explore for answers as well as making plenty of mistakes along the way, which if used with an open mind, are almost always learning steps. His concept of guidance was to sit or walk with a station member and push, probe, question and in most cases, have the challenge of the problem-solving in the hands of the student.

I believe that this courageous chance taking and belief in people, coupled with John's capability to delegate complete responsibility to individuals proved in many ways that he was an ultimate student of human nature. I know that rare quality, that way of being Director, was a great stimulation to many. To be with Dr. Marr was to learn.

Kathy Hansen

I will always remember the weekly rides for almost five years with John Clark up to monitor and maintain the weather stations on Niwot Ridge. The weather seemed to always be harsh, and John would coax the Sprite up the trail, flawlessly, and somehow we kept warm and safe. It was always interesting to see just what we would find. In the summer the Stevenson screens might house a million flies that had hatched in the microclimate of the instrument shelter. In the winter the screen often was filled with windblown snow, and the clock may have failed due to the cold! I also remember the wonderful family of friends and fun times at the Mountain Research Station. The Thanksgiving Day turkeys, the international visitors, the summer students and professors, the skiing, the weddings, the celebrations, the NASA project, the potluck dinners, and all the laughs will forever be a part of my memories of INSTAAR. Of the 30th Street building, I will always remember the interest almost everyone had in what the weather was like at the station. How cold were we? What were the roads like? Those of us from the station would all look like we had just emerged from somewhere afar. And, of course, I remember fondly the famous Christmas parties in the library!

Darvel Lloyd

Of the 27 memorable visits I made to the Isabelle Glacier during the yearlong field season for my thesis, one really stands out. It was on that fateful day of January 26, 1969, when my twin brother, Darryl, and I were climbing back to the D-1 research hut through about a meter of newly-fallen snow after servicing weather instruments at the glacier earlier in the day. On January 25, the day before, 150-mph winds were recorded at NCAR's gauge on Niwot Ridge. While I was cutting across a steep, north-facing gully near the top of Niwot Ridge, a thick slab avalanche broke loose and took me on a wild and scary 500+ meter ride to the bottom of the ridge. Luckily, I wasn't buried in the run-out zone and was able to drag myself back up the ridge to D-1, where we radioed Skip Greene, manager of the Mountain Research Station. I was too bruised and stiff to ski out, so Skip came to the rescue that night with the snowcat as another storm brewed. We made the newspapers the next day, and I was on a "high" that lasted for weeks! A year later, my brother and I established a wilderness mountaineering school on Mt. Adams in Washington State, attempting to pass along some of that painfully learned, seat-of-the-pants "wisdom." We operated it successfully for ten years. Some of my other jobs during the past 31 years include: lecturer at the University of Winnipeg for two years, adjunct lecturer with Central Washington University for five years, director of the Keystone Science School, Colorado for three years, program director and instructor at Colorado Mountain College for four years, and owner/innkeeper of the Flying L Ranch, Washington for 11 years. We sold the ranch/business, and I now serve the frail elderly in Portland, Oregon for a nonprofit organization.

David Lubinski

Let the field season begin: How Aeroflot turned a 48-min flight into a 48-hour adventure

CHALLENGES ARE TO BE EXPECTED when working in remote regions like arctic Russia. Nonetheless, it's possible to be caught off guard, particularly when the challenge materializes before you even arrive in your host country. In 1992, Steve Forman (now at University of Illinois, Chicago) and I had a memorable experience at the start of our second Franz Josef Land field season (collaboration with the Murmansk Marine Biological Institute—MMBI). The season itself eventually turned out to be a big success despite the inauspicious beginning.

Our adventure started at the Rovaniemi Airport in northern Finland. Steve and I were awaiting a flight to Murmansk, only a short distance to the northeast. When it came time to check in, I approached the ticket counter, handed the airline agent my ticket, and then watched his eyes go from the ticket to me, back to the ticket, and finally back to me. "Sorry sir, but there is a problem. There have been no flights to Murmansk this year by any carrier; the last Aeroflot flight was two years ago." Somehow Aeroflot had managed to sell us tickets for a flight that didn't exist *and* their New York office confirmed the flight 24 hours in advance! Now what were we going to do? After a few hours of international phone tag, it became clear that the best option was to fly to Helsinki Airport, far to the south.

Many hours later, we met with the seemingly sole Aeroflot agent for all of Finland. He proceeded to give Steve new tickets to Murmansk. He then discovered that I wasn't in the Aeroflot computer system and, thus, couldn't help me. Never mind that I had already been sold a ticket for a fictitious flight by an Aeroflot computer system! His view reached absurdity when he uttered "how do I know that you don't have a travel agent

friend who gave you a ticket for free, never booked you on the flight, and set it up so that you could fly at Aeroflot's expense?" By now the discussion had turned into argument. I was not going to leave that office until I got a ticket to Murmansk. Did he crack? Did I? Neither. The first to succumb was the poor SAS agent who was sharing an office with Aeroflot. In the end, this agent kindly paid my way to Murmansk.

After spending the night in a Helsinki Hotel, Steve and I boarded an afternoon Aeroflot flight to St. Petersburg (you didn't think you could fly direct to Murmansk did you?). The flight was uneventful other than the blue disinfectant oozing out of the vents during boarding and the fact that the seats hinged forward (all passengers would become a line of toppling dominos in the event of even a minor crash?). Once through customs we had to spend the night in St. Petersburg. The next flight to Murmansk wasn't until early the next morning.

With a whopping four hours of sleep, we were ready for the final stage of our journey. The plane took off and landed on time. The problem now was the location. Where were we? Both Steve and I had flown to Murmansk the previous summer, and this was definitely not the Murmansk Airport! Our MMBI hosts were nowhere to be found. Our poor language skills only allowed us to establish that we were indeed somewhere near Murmansk. The luggage was soon pushed from the plane directly into a truck and then unceremoniously dumped into one huge pile of about 100 pieces. The well-behaved crowd graciously let the older folks make the first ascent for their bags. By the time we located all our field equipment and personal gear, several buses had arrived. It seemed best to not board one; instead, we decided to try to wait for our MMBI partners.

There were no nearby buildings, phones, or people (everyone but us had left by bus). Our only company was the low cloud cover,

which generously shared some of its moisture with us. About 30 minutes later, we saw a familiar figure in the distance jogging through the puddles. It was our MMBI colleague Sergei who, upon arriving, said that the Murmansk airport was closed for repairs so all flights had been diverted to a military runway tens of kilometers away. He apologized for being late. The military police wouldn't let the Institute's car past the second gate, closest to the runway, so he had to jog the last km. Fortunately, the car had gotten through first gate; otherwise, we would have had to haul our bags three times as far. Finally, something was going our way. Let the field season begin!

Lazarus Macior

INSTAAR played an important role in my career as an arctic-alpine pollination ecologist. My introduction to the alpine tundra occurred in the summer of 1964 while attending the International Congress of Systematic and Evolutionary Biology held at CU-Boulder on a brief jeep trip to Niwot Ridge and a visit to the INSTAAR station. Since the visit was too brief and the tundra too fascinating, I resolved to return as soon as possible. As good fortune would have it, at the Congress I met a former fellow graduate student then on the faculty of the University of Wyoming who invited me to teach a NSF Summer Institute in Biotic Communities in the Medicine Bow Mountains in 1965. Late that summer I visited John Marr at the INSTAAR station and planned fieldwork on Niwot Ridge with grant support from the National Science Foundation. It was that experience in the alpine life zone, begun in 1966, that oriented my research for the next 33 years with subarctic and alpine field studies in the Rocky Mountains (Colorado, Wyoming, Montana), Mt. Rainier, the California Sierra Nevada, the Tetons, Yukon Territory and Alaska, Honshu and Hokkaido in

Japan, the Indian Himalaya and most recently (1996–1998) in the Chinese Himalaya. It is with heartfelt gratitude that I reminisce on all those who made this wonderful experience so joyful and meaningful. John Marr and all the others at INSTAAR will always remain in my fond memories.

Philip C. Miller (from Patsy Miller)

Dr. Marr's graduate student, Philip C. Miller, and my remembrances of "Science Lodge"

PHILIP C. MILLER was Dr. Marr's graduate student from 1960 to 1964 when he completed his Ph.D. His dissertation was "Factors influencing the vegetation pattern on the White River Plateau in northeastern Colorado". He was on the faculty at San Diego State University from 1965 until his death in 1982. His research focused on ecosystem energy budget studies, plant water relations, and developing process models of arctic tundra and Mediterranean type ecosystems. He was director of the System Ecology Research Group at San Diego State, wrote numerous papers, edited three books, and advised many graduated student who have gone one to their own careers in ecology.

Some tidbits about "Science Lodge" as we called it way back in 1960 and 1961 when Philip and I lived in two of the one room cabins next to the reserve kitchen which we shared with another family.

One of my vivid memories of "Science Lodge" was when Philip, Jeffrey (as a one year old) and I spent the night of July 4, 1960 in the metal cabin up at "D." As is common in July there was a terrific convectional storm that evening. It seemed that the cabin would tumble down the side of the mountain at any minute. I kept reassuring myself that the cabin had been there for many years, was well grounded from lighting strikes, and would probably make it

through the night. It did, but I was rather glad to see the sun the next morning.

I also have a vivid memory of John Clark giving all of us a lecture on what to do if one was caught on Niwot during a lighting storm. Three hikers were killed by lighting that summer while hiking in the Front Range (I think up the Fourth of July Valley) and John had been involved in bring out the bodies.

Christopher Miller was probably the youngest resident at Science Lodge when he moved up from Boulder on May 29, 1961 when he was ten days old. He spent the summer sleeping in a cardboard box in our one-room cabin next to the reserve kitchen. He survived the experience quite nicely and has gone on to get a Ph.D. in marketing from the University of Oregon and is now on the faculty at Santa Clara University.

During the summers of 1960–61 the volleyball net was always up after dinner and every one was invited to play, from the youngest kids (usually Bill Osburn's daughter) to the most senior faculty member.

During the summer of 1961 the art of beer making was being refined in the reserve kitchen, but there was a problem with the bottle caps, which kept blowing off at some crucial point in the process and making quite a mess.

One of the highlights of the summer was going down to the Gold Hill Inn for roast suckling piglet.

The weather data from "B," "C," and "D" on the transect up Niwot Ridge had to be copied from the strip charts and summarized by hand, then checked and rechecked three times to insure accuracy. During the summer of 1961, Philip Miller spend many long hours writing a computer program to automate this chore. At the time the University of Colorado did not have a computer. He had to go to Colorado State in Fort Collins to run the data reduction program. As I recall, some of his fellow graduate students thought using a com-

puter to reduce data would never work and that the effort was a waste of time.

During the summer of 1973, Dr. Philip Miller's 23-foot motor home containing a Vidar data acquisition system was air lifted to "C" by the largest military helicopter available so his graduate student Jim Ehleringer (now Dr. Ehleringer at the University of Utah) could collect micro met data to validate the ARTUS model. (Jim can provide more detail on this research, we were doing IBP research in Barrow, Alaska that summer.)

During the summer of 1975, a rotating group of arctic researchers joined Jerry Brown, Philip Miller, Larry Tieszen, and Fred Bunnell, editors of the USIBP tundra biome synthesis volume, to write chapters for *An Arctic Ecosystem*, the coastal tundra at Barrow, Alaska, which was later published as volume 12 in the series.

Mark Paddock

Some prehistory of INSTAAR

THE UNIVERSITY OF COLORADO'S location on the Great Plains at the eastern edge of the Front Range and only twenty miles to the Continental Divide provides an almost unlimited variety of environments in close proximity to the campus. This has, since the very earliest days of the university, provided inspiration for field research in the mountains by its biologists, geologists, and geographers. One of America's first ecologists, Professor Francis Ramaley came to the University in 1898 and soon became convinced "that the University make provision for instruction in mountain zoology and botany." He received approval of the Regents in 1908 to establish The Mountain Laboratory in Tolland a village at 8,900 feet elevation on the main line of the Denver Northwestern and Pacific Railroad (The Moffat Road). Tolland lay at the foot of Rollins Pass, 11,990 feet, over which the railroad line

climbed to reach the western side of the Continental Divide. Students and scientists could walk to timberline from Tolland in a couple of hours but it was easier to catch a local freight train in the morning jumping off when desired or riding all the way to the pass. Usually the same train crew came back down the track in the afternoon and since the crew lived in Tolland and were friendly with the Mountain Laboratory, they slowed the engine down so people could climb on.

The Mountain Laboratory was in operation for ten years closing in 1919 for various reasons, one of which must have been the construction of the Moffat Tunnel under the Divide and the closing of the rail line through Tolland and over Rollins Pass. From then on teaching and research in the Front Range by the university was centered at University Camp, 1915–20, and Science Lodge, 1921–present, near the Arapaho Peaks area and the City of Boulder Watershed.

Memoir I

ON A COOL SUMMER MORNING in 1953, we four were working in the office above the kitchen-dining room at Science Lodge. To take off the chill, we tossed some waste paper into the stove and a couple of pieces of kindling. It soon began to roar satisfactorily. About half an hour later, one of us noticing the stove continuing to roar got up to close the damper. But there was no flame, only a few coals. Trying to determine the roaring sound's origin, he glanced up at the ceiling and noticed a red glow of fire next to the stove pipe. The ceiling and the roof were on fire! While we started to fight the fire, our wives, still in the kitchen, ran up the stairs, grabbed the irreplaceable files of data and carried them to safety. Someone found an axe and chopped a hole in the wallboard ceiling; someone else found a large CO₂ extinguisher and directed it toward the fire. The other two of us found

a ladder, climbed up on the roof with buckets of water and threw it on the burning wood shingles. In a few minutes the fire was out leaving only a burned out hole a few feet in diameter. We knew that we were only a few minutes away from losing the entire dining room and probably some nearby cabins, as well. A catastrophe was averted by good luck and quick action. From then on, we instituted fire fighting procedures, bought some appropriate equipment and showed more caution.

Memoir II

DURING 1952–53 we in the IAAR were attempting to obtain a year's complete record from the sixteen environment measurement stations located in a rough transect from the Sugarloaf area to the west end of Niwot Ridge, from 7,200 to 12,280 feet. Four "Climax Regions" were measured, each with four stations: ridge top, north-facing slope, south-facing slope, and valley bottom. On Niwot Ridge, the Alpine Tundra Climax Region, these stations were referred to as the "D" stations. All stations were serviced weekly.

Al Knorr (Dr. Owen Albert Knorr) and I were scheduled to service the "D" stations one July day in 1953. We left Science Lodge and drove a jeep to timberline, parked below the large snowdrift, and walked up the ridge. It was a lovely, quiet, clear summer day without the wind so often present on Niwot. We hiked along the trail to D-1 following a telephone wire we had laid down just one week before. Ever since we had erected the D-1 "Lab" the previous autumn, we had felt the need to have some way to communicate between D-1 and Science Lodge. Radio was not practical and/or too expensive, but Army field telephones and coated field telephone wire were available to us. Having been in a "wire platoon" while in the U.S. Field Artillery, I knew a bit about

laying telephone wire in the field. So we ran wire from the dining hall at Science Lodge (now Mountain Research Station) up to D-1 and hooked field phones on each end. Right after we finished, we cranked the phone to call down to the Lodge. Someone answered—it worked!

Al, with "Wimpy" his cute black and white collie-shepherd mix, and I reached D-1 about 10 A.M. A few cumulus clouds had gathered over the divide, as is typical. We decided to service D-4 first and hiked down into the Green Lakes Valley just up from Green Lake Four, serviced it, and headed back up toward D-3. By this time it was late morning and clouds were building rapidly, but no thunder was heard nor was any rain falling. We opened the shelter and started the proms of recording data, removing the charts and rewinding the clocks. Without warning a tremendous flash and deafening explosion occurred. We felt a strong electric shock and were either knocked or threw ourselves to the ground. "Wimpy" yelped and ran cowering and shaking to Al. After a few seconds I looked up toward the ridge and the D-1 lab, although the lab itself was hidden from view. I saw a huge black cloud of smoke drifting slowly to the east and thought, "Oh no, there goes the Lab building!" We continued to hug the ground and prayed for no more lightning. After about 30 long minutes on the ground, the sky cleared a bit so we hurried nervously up slope to where we could see the D-1 lab. It was untouched! What was the cause of all that black smoke? Then we noticed a long, black swath on the sod leading east from the lab. We followed that burned path for some distance, then began seeing bits of severely burned wire. The lightning had struck a rock, jumped a few feet to the wire, and vaporized it for about 150 yards, creating a furrow in the damp sod about six inches wide.

D-1 lab with a thick copper wire embedded in the soil and mounted on lodgepole

pine poles stretching over the building was fine and as far as I know has not been damaged by lightning to this day, 48 years later. We were chagrined to have been so incautious. Lightning is a very serious danger in the high mountains. From then on, we talked about the possibility of being “Zapped” as we called it, and paid proper caution.

The telephone line was never relaid; its first message was its last. “Wimpy” was nervous about lightning for the rest of his life and I never really felt comfortable in summer on Niwot Ridge from that day on.

Marith Cady Reheis

MY FIRST SUMMER at the Mountain Research Station in 1971 as an undergraduate participant in INSTAAR’s NSF-funded research assistantship program changed the course of my life. I was a frustrated junior majoring in geology at the conservative, clinging-to-the-Old-South campus of the University of Georgia. I couldn’t find a summer job in geology because the oil-company representatives wouldn’t hire a female (in those pre-liberation days, they would say so to my face!) and none of the professors dared take a female field assistant on their summer fieldwork. In desperation I applied simultaneously to the INSTAAR program and to a Women’s Officer Training Program at Annapolis. My application arrived late to Boulder and so I was on the waiting list there, fending off the Navy until the very last minute in mid-May when an opening appeared in the INSTAAR program. I was off to Colorado to help Jim Johnson on his Ph.D. work on glacial mass balance in the Front Range, with a crew of three high-school students, one of whom was Keith Echelmeyer.

What a revelation for an East Coast girl! In three days I made the transition from 500 feet in altitude in Georgia to 3350 m on

Niwot Ridge, and never looked back. Jim’s crew backpacked twice a week into Arapahoe and Arikaree Glaciers for 2–3 days each, establishing and surveying ablation stakes, probing for depth to summer ice, and digging deep pits to measure snow density. We spent nights in tents on the cirque moraines and hiked the peaks for sport. That wasn’t enough to satiate me, so Keith introduced me to rock-climbing; on our weekends off, we two would pack into other mountain areas to climb and survey glaciers.

Some of the strongest memories of our fieldwork that summer, and the ones my children enjoy hearing the most, revolve around the constant battles with ravenous marmots! They infested both the cirque moraines and the water-storage dams where we parked vehicles at the trailheads. And they would eat anything that wasn’t metal, including gas lines, oily ignition wiring, and plywood. Oh, the ceremonies of starting a 3-day hike: everyone taking turns to pee on the scrap pieces of plywood we would leave near the vehicles (urine-soaked plywood was a marmot delicacy, but only worked as a diversion until all the flavorful parts were eaten, usually in less than 48 hours); opening the hoods and filling every small space in the lower part of the engine compartment with chunks of wood and heavy rocks to keep them from climbing into the wiring; throwing rocks at the furry devils for entertainment. And yet we still had to walk out from the trailhead several times. The marmots would eat everything left in the cache cans (except cayenne pepper) if they could knock the boulders off the lids, and once attacked the back of our tent when we were cooking inside!

Will Rense

The "GOD" Zot

A vignette from the summer of 1965

THE SUMMER OF 1965 was cold and wet, and followed a cold, wet winter.

I was working then at the Research Station (we still called it "Science Lodge" in those days) as an undergraduate summer employee. My duties were varied, but focused on the climatological data program.

The Institute had gotten badly behind in the climatological data reduction process and something like a year's data from the four environmental stations of A-1, B-1, C-1 and D-1 (as they were then designated) were still in rough form on original field sheets and instrument charts. I was thus assigned the job of reducing these data to the proper format. This was a detailed and time consuming process, but working with climatological data has always been a love of mine and I was generally enjoying the task.

However, on one particular day in July I had been working with the thermograph charts from C-1 for hours, as I had been for many days. It seems that the raw data from the C-1 station were particularly ornery that year and even I was beginning to lose patience!

Paula Lehr was working in the lab that afternoon and around 4 o'clock she turned to me and asked how I could stand to keep looking at those charts for hours at a time, day after day. Being exasperated after a long day of trying to decipher indecipherable thermograph charts, I threw my arms up in the air and said: "Oh great God Zot, strike down the C-1 station and deliver me from this agony."

The term "zot" came from a popular cartoon, (*B.C.*, I think, or *Wizard of Id*) and referred to lightning. In the lab parlance of 1965 "zots" were lightning strikes and getting "zotted" was to have strikes occur very near to you.

Anyway, the words were barely out of my mouth when there was a flash of lightning on the hill above the lab and a clap of thunder that shook the whole building. Paula gave me a strange look and then avoided me for the rest of the summer!

That evening I walked up the hill to the C-1 station and half expected to see it in smoking ruins. However, nothing was amiss and all was in order. Whatever the lightning struck, it wasn't the station and I spent the rest of that cold, wet summer in the lab, hunched over thermograph charts, field notes and other extraneous data records. "Zot" had spoken, but not in fulfillment of my prayer.

Bill Rickard

Memoir I

IT WAS A MID-WINTER DAY on Niwot. Air temperature was 17 degrees F. and wind speed was 25 mph. The air was filled with blowing snow and it was my turn to hike down to the Green Lake Valley to service station D-4. My intent was to walk to the top of a snow bank that extended downslope to the valley floor, glissade down the snow bank and walk to the station. As I stepped out onto the upper edge of the snow bank, I noticed that the snow was soft. As I paused to consider what to do next, a crack in the snow appeared at my feet as the upper part of the snow bank slipped away downslope gaining speed. I then walked to a nearby rocky but snow free ridge and hiked down it to the station. On the return trip, I decided that this was to be my last winter on Niwot.

Memoir II

I WAS INTERESTED in learning more about the native species of cutthroat trout that inhabited the various watersheds in Colorado. Among these was the greenback which historically inhabited the mountain

streams that fed into the South Platte River. I had fished for Colorado River and Yellowstone River cutthroats but had never seen a greenback cutthroat. Como Creek, the small stream, that flows through the Mountain Research Station property on its way to join North Boulder Creek, supported a few small fish. Mark Paddock captured several of these, took a photograph and I preserved a specimen in formaldehyde solution and placed the jar in a cabinet of one of the abandoned classroom buildings. At this time I thought that the fish might be a greenback, but most biologists thought that the greenback to be extinct because of over fishing, habitat degradation and inbreeding with introduced cutthroat.

In September 1953, I left Colorado to attend Graduate School at Washington State College. I thought about the Como Creek trout and wrote an article for "Colorado Outdoors" magazine suggesting that a few greenbacks might still exist in small isolated mountain streams.

At about this time, fisheries biologists from Colorado State University were interested in greenbacks, and Bill Osburn remembered the preserved specimen at Science Lodge. In time the Como Creek fish were identified as greenbacks, other populations were found and successfully propagated and planted in streams in Rocky Mountain National Park and elsewhere. Today, the greenback is the state fish of Colorado.

Kathleen (Blackie) Salzberg

WHEN I ARRIVED in Boulder from Scotland in October 1967, I never expected to be here 34 years later, having had a vague idea that Colorado would be the first stop on my round-the-world tour. It proved to be the first and last stop. Boulder's ambiance, the people I met here, and my job as managing editor of the fledgling journal, *Arctic and*

Alpine Research kept me here. Having been part of INSTAAR for more than half the its life, I have encountered many changes and people—four directors, countless graduate students, visitors, and researchers and faculty, and, most especially, changes in the way my work with publications is done. In 1967, we used manual typewriters, carbon paper, and pen and ink drawing and stencil lettering for maps and graphs. Now almost everything is digital. The pace is faster, but overall the electronic age has improved the way we work and communicate and ultimately the quality of the product. The journal has grown from around three hundred 7 x 10-inch pages (1969) to more than five hundred 8 1/2 x 11 inch pages (2000); it has an expanded scope and name (*Arctic, Antarctic, and Alpine Research*); and achieved high ranking as international journal. I have experienced an exciting revolution in an exciting work environment.

It is hard to forget some of the early days in a much smaller INSTAAR. I remember the guidance given me by Carol Haverkamp, the institute secretary, when I arrived. She instructed me, a very green editor, on the fundamentals of office practice and proper forms of address, information that I value to this day. Carol was of the "old school" of well-trained secretaries who believed in doing things correctly. Another memory of that first winter in Boulder was my first attempt at cross-country skiing. John Marr equipped me at the Mountain Research Station with Army surplus skis which had been narrowed down, but were much too long for me. Needless to say I took many tumbles on the descent from T-van. I remember another tumble on Niwot Ridge. In the early 1980s, when INSTAAR was still relatively small, Pat Webber closed the Boulder campus office for the day so that all the staff and families could participate in an all-INSTAAR hike to D-1. Descending from the ridge with John Hollin after an enjoyable day, I tripped and fell flat on my face, much to the

embarrassment of my then-young son who was with us.

There are many other happy, and frustrating, times I could mention here, but suffice it is to say that INSTAAR has been a formative and valuable part of my life for most of my career.

James P. M. Syvitski

CSS Hudson collision with Greenland iceberg

BETWEEN 4 AND 16 SEPTEMBER 1993, scientists from Canada (GSC-A-BIO), United States (INSTAAR), and the United Kingdom collected geological and geophysical data between Iceland and Eastern Greenland. The cruise (CANAM-PONAM Cruise HU93030) continued the efforts of scientists from Geomar (Germany), the Danish Geological Survey, the Icelandic Marine Institute, the Virginia Institute of Marine Sciences (U.S.), the Institute of Arctic and Alpine Research (U.S.), the University of Calgary (Canada), Institute of Oceanology (Canada), and the Geological Survey of Canada. The scientists who lead the cruise were James Syvitski and John Andrews, and they were aided amongst other scientists by fellow INSTAARs Kerstin Williams and Nancy Weiner.

The cruise collected excellent data making four significant contribution: (1) ascertaining the role of turbidity currents and debris flows within environments where deltas are not present; (2) revealing the role of *sikkussaqs* or iceberg/sea ice shelves fronting the larger tidewater glaciers and their affect in controlling sedimentary processes within the fjords; (3) revising our understanding the role of iceberg calving and rafting on sediment accumulation distal from the ice margins; and (4) collecting diverse data that will help define the role of subglacial sediment transport through a fjord and onto the continental slope during

periods of ice sheet expansion. While that all sounds wonderful, and indeed produced great science with many excellent research papers published from data collected, the ship was to sail to one of the most dangerous places on this planet. First, lets call up the facts. Kangerlugsuaq Fjord, on the eastern coast of Greenland is about 5 km wide, 80 km long, and 900 m deep. It receives more iceberg mass (a total volume of 17 km³ comprising over 1,000 large icebergs) than any single fjord in the world. Icebergs extended 600 m below the sea surface and towered some 80 to 100 m above the water line. Cruise participants were literally sailing into the ice age. This is a report on our adventure of hitting one of these icebergs and having its hull cracked open.

As we sailed into Kangerlugsuaq Fjord, on 9 September we encountered distributed ice conditions of about 1/10 to 3/10ths density including bergy bits, growlers, icebergs, first and multiyear sea ice. The large open patches of water meant that we were able to deploy moorings and collect station data (cores, water samples, etc.) but would not be able to deploy our seismic gear. We had heard conflicting reports from local Inuit, whom we met in the outer fjord reaches, on the ice conditions further up the fjord, and in hindsight both reports were true—there were places where water was more open and locations were floating ice was dense. We reached the head of the fjord and proceeded to collect oceanographic data that evening. We maintained our position in an upwelling zone that we termed the “pool” at the head of the fjord. Snow fell through the night forming slush-ice pans. Freeze-up had begun.

On 10 September, A.M., we cored at our location at the head of the fjord, and deployed a remotely operated submersible to examine the ice margin. In the afternoon we moved down the fjord to collect another long core. The ride down was rather bumpy

as we the captain moved the ship among the slush ice and bergy bits. We return trip to the “pool” was much smoother, as the first officer managed to avoid hitting ice. The ship was then in a circle within the pool towing seismic gear such that the floating ice was kept free of the towed instruments. The evening was used to collect oceanographic data and samples within the “pool” waters.

On 11 September, I had informed the captain that we should begin working our way down the fjord. Along the way we could check out seafloor conditions near the entrance to Nordfjord, a branch of the main fjord system, if sea-ice conditions allowed such investigation, otherwise we were to return to the entrance of Courtauld Fjord. The captain took a direct route to Nordfjord through iceberg surface densities up to $4/10$ ths. A 300-foot vessel does not turn on dime, and ship-speeds through such ice are typically at about 3 knots. Along the way the ship was forced to go between two relatively small icebergs that were very close. The impact with the first iceberg pushed the ship into the other iceberg. The sound of the impact was alarming. We knew something was wrong. The ship started to list as we took on water. At the time we did not know where the hull damage was located, or its extent. The ship began to list to starboard, first to 3° , then 5° , at which time I began to scan the sea surface in case I had to jump ship and swim for a floating ice pan. We continued to list to 9° to 11.5° where we stopped taking in water. Altogether the ship had taken in 1,000 tonnes of water. Shortly after we discovered that one of our empty fuel tanks (that was fortunately water-tight to the rest of the ship) had filled with seawater.

We sent our communications messages pack to Canada informing them of our situation. While the powers worked to rescue us, we drifted without engine for another 37 hours. During that time we deployed our submersible to locate and inspect the dam-

aged hull. Eventually the Danish Navy supported Canadian efforts by sending a dive team to repel onto the ship deck from a Navy helicopter. They then entered the frigid waters to visually inspect the damage. The hull was found cracked to a length of 12 feet, 3 inches wide. Two full plates were damaged. to ascertain damage and obtain port repair. The Danish Navy helicopter survey then survey the fjord to map out an ice free corridor, from which the ship was to sail out of the fjord. On 14 September the ship sailed out of the fjord where a second diver team inspected the damaged hull to determine if the crack had changed in dimensions. The *Hudson* was then joined up to the Danish Frigate *Triton* and escorted to Iceland for dockside inspection.

During the time the core logging team of INSTAAR scientists of John, Kerstin, and Nancy continued to work, logging cores and making the most of the ship equipment. Others had become panicked and were sedated by the ship’s nurse. Still others talked of other ways of making a living. I have spent over three years at sea, and I say without modesty that the INSTAAR scientists were second to none in this world-class misadventure.

Bruce Vaughn

Trouble on the Ice

IN MAY OF 1990 Jim White and I went to the summit of the Greenland Ice sheet to be part of the Greenland Ice Sheet Project (GISP2) field team to help recover and analyze the now widely known Greenland ice core—which has been used extensively for paleoclimate reconstructions. One of them almost didn’t make it back.

After spending more than two weeks at sea level in Sonderstromfjord on the West coast of Greenland, organizing supplies, and waiting for good weather, Jim and Bruce boarded a ski-equipped Hercules C-130 aircraft bound for the

summit site at the center of the Greenland Ice Sheet some 12,000 feet higher. We landed in a storm, and quickly set up our tents as a part of the early season skeleton crew. Hard work digging snow trenches in windy -30°C conditions left us tired. Within 48 hours, I experienced difficulty breathing, and while in my tent late on their second night, I began coughing up blood- a symptom of an advanced case of high altitude pulmonary edema (HAPE). This acute altitude sickness was brought on by our rapid ascent and elevated level of activity upon arrival. In normal mountaineering conditions the only real cure for HAPE is a quick descent. Oxygen can help for a while, but left unchecked, the advanced condition is usually fatal within days or even hours.

The ski-equipped aircraft that had delivered us to the ice sheet had already returned to New York, and the storm on the ice cap had degenerated in to a full on white-out. To further complicate matters, the Earth was in the middle of a serious ionospheric disturbance, making radio contact with the outside world impossible on the existing equipment. This was also the early days of satellite communications, and the new ability to TELEX via satellite was just getting set up at the European ice core camp (GRIP), some 30 km to the North of where Jim and I were. Communication with INMARSAT in London was possible for about 4 hours a day, when the satellite was above the horizon at this high latitude. Others on site quickly mobilized and sent a snow machine to GRIP to get a message out on this system before the window of communication ended for the day. INMARSAT then telephoned Steve Peterzen at the field operations base (FOB) station in Sonderstromfjord passing on the bad news. From there, a rescue plan was formulated, but the biggest problem aside from the weather, was that there were no planes nearby equipped to land on the ice sheet on the West Coast of Greenland and it would take too long for the C-130's to return from

New York. FOB quickly arranged for an emergency plea to be transmitted to all aircraft flying over the North Atlantic in search of a ski-equipped plane. Finally a small ski-equipped Icelandic Twin Otter aircraft on the East Coast of Greenland responded to the plea. The two pilots, (who were in their mid 20s) filled the inside of the Twin Otter with 55-gallon drums of fuel to make the distance, and headed off for the center of the ice sheet with little more than a compass heading. It would take them four hours.

By now I could only breath with the aid of oxygen, which was in short supply. He continued to cough up blood while the blizzard continued to howl outside. Meanwhile, Peterzen back at the FOB had realized the seriousness of the problem and pleaded with the Royal Danish Airforce in Sonderstromfjord to launch their Gulfstream Surveillance Jet with a box of oxygen tanks attached to a parachute. Peterzen accompanied the jet, and made quick time to the GISP2 site, where the conditions remained zero visibility, with a zero cloud ceiling. The oxygen was dropped somewhere near the site, but according to witnesses on snow machines trying to chase the air-drop, the "White box with a white parachute was quickly blown out of view by the strong winds"- making recovery a near suicide mission. Time was running out along with the oxygen. But the Twin otter, now within range, had little hope of being able to land in white out conditions. In a twist of fate, the Royal Danish Airforce jet was able to home in on the radio transmitting beacon that marked the ski-way landing strip on the ice. In this way they could act as a control tower in the sky, guiding the Twin Otter in its blind descent onto the snow white surface of the ice cap. Once on the ground, there was confusion. They had landed at the GRIP ski-way, some 30 km away from GISP2 where we sat waiting for rescue. After taking on fuel, the Twin Otter decided to try to fly the line of bamboo

flags- spaced at 200 meter intervals between the two camps and twice failed— losing site of the flags each time. Once back on the ice at GRIP, they radioed the GISP2 camp requesting that I be transported by ground to the plane for evacuation.

Existing at the grace of bottled oxygen, I was getting weak and was unable to ride on a snow machine, and the Tucker snow cat in camp was broken. Instead, a German track vehicle, driven by two Italians was dispatched from GRIP to do the transport. Jim and I left GISP2 in the storm for the two-hour ride in the track vehicle with just one hour's worth of oxygen. A decision needed to be made. Jim turned on the oxygen and allowed me to breathe for several minutes, then shut it off. As the minutes ticked by my attempts to breathe without oxygen were labored and Jim watched the color of my lips turn light blue. On again went the oxygen for another two minutes, and so it went—on and off—like this for two hours in what they later referred to as the “blue-lip express taxi” to the waiting rescue plane. All was going well until suddenly the track vehicle sputtered to a dead stop, still miles from GRIP. Snow had clogged the air intake and it took the two Italian drivers about 20 minutes to fix it. Growing worried, the ground crews waiting for the track vehicle sent out snow machines to rescue us, but when they arrived the vehicle was up an running again.

The track vehicle, now with multiple snow machine escorts, finally reached the Twin Otter, which was powered up and ready for take off, awaiting its patient. Jim and I had to explain to the pilots that I could not be placed on a stretcher, as they had planned. Victims of HAPE need to remain upright; or else the fluid in the lungs will cover more lung surface area, and make things worse. The Twin Otter had indicated that it had oxygen on board, but they discovered that it was only one bottle, capable of a scant two-hour supply at the rate that I now required. The flight to the nearest

hospital in Jacobshavn on the West Coast was more than 4 hours flying time. The logical alternative would have been for the plane to make a rapid descent to a lower elevation, where the increase air pressure and oxygen would likely allow the patient to breathe. However, the storm and its associated cloud deck required the unpressurized Twin Otter to climb to 15,000-ft level, and fly above the clouds until a safe descent path could be found. Once again, the “blue-lip express” method was used to budget the oxygen for the long trip. After four hours, the plane was still at 15,000 feet. They would look at the crew and point to the watch, as if to say “How much longer?” The crew kept saying in Icelandic—English: “15 more minutes”. This went on for a half-hour, while the passenger's view of the cockpit told another story: both pilots were staring blankly at aviation maps of Greenland opened so wide that they filled the cockpit. After a while, one pilot nudged the other and pointed to a hole in the clouds. The next moment the plane entered into a steep dive, spiraling down through the hole, with both pilots scanning the horizon. Finally mountains and steep fjords came into view, and out again came the maps, followed by lots of finger pointing. Things were looking better.

As the landing gear touched the runway, the needle on the gauge of the oxygen bottle finally went to zero. The airport, which had kept open its control tower six hours beyond its normal closing time was filled with on-lookers as the ambulance met the plane. Some how, the words “medical evacuation” had conjured up gruesome expectations on their part, and so it was quite a surprise when we walked off the plane.

I spent several days on oxygen in the hospital in Jacobshavn, where two people spoke English, the rest used Danish or the even harder to understand Greenlandic tongue. X-rays showed severe accumulation of fluid in the lungs, indicating that the swift departure was a lucky one. However the recovery

was rapid, and within the week I was released, and the hospital, uncertain what to charge to a foreign national, invented a fee that turned out to be less than the rate for the local hotel where Jim was staying.

I have many people to thank for surviving the epic time on the ice sheet. Without the help of dozens of people, I would not have survived. This incident helped underline the risks of even moderately high altitude work on the ice sheet, and the dangers of the remote location. In the following years, more precautions were taken at the GISP2 site that allowed all a safer stay on the ice. A medical doctor and more oxygen tanks were put in place each field season, and a portable hyperbaric chamber (Gamov bag) became standard equipment on site. With these precautions Bruce was able to return to GISP2 site and worked with the ice core for two more seasons. Jim White and I still continue to be heavily involved in ice core research at INSTAAR.

Peter Wardle

For us it is a year for 50th anniversaries: the New Zealand Ecological Society, the ski club that Margaret and I belong to, and now INSTAAR! Also, this year I celebrated my 70th birthday, so that works out to about 50 years of plant ecology in the mountains. We are sorry that we won't be able to attend the INSTAAR celebration on September 15–16, but will certainly have the Institute in mind.

Our year in Boulder (August 1963–August 1964) was wonderful for us both professionally and family-wise. We made an inauspicious beginning, arriving with a rather sick 2-year-old daughter. But through the kindness of Bob Krear, we got her to a good doctor, and thereafter all was well. By the time we returned home, Penny was talking well, with an American accent that wowed the locals; she reverted to it when she spent a year at high school in upstate New York as the recipient of a Rotary studentship. Our son Robert was born in

Boulder, and spent many days of his babyhood parked in his pram under a pine tree at Science Lodge. He has dual citizenship, which he turned to advantage when he earned the money he needed to attend university in New Zealand by working in Alaska and Utah.

In the New Zealand mountains the climate is comparatively non-seasonal, so Margaret and I found the march of the seasons in the Rockies truly inspiring, especially the sequence of alpine and forest flowers. We also enjoyed the wild mammals, even the chipmunks that John Marr referred to as “varmints”—the mammals that we have in our mountains are unfortunately all introduced pests that threaten the indigenous biota. The Front Range was a very rewarding place to study timberline, and it was especially interesting to compare your highly continental situation with our insular timberlines composed of quite different trees. Skip Greene set up a special van for my use at the upper limit of tall trees, and for years after we returned home visitors to the Mountain Research Station commented on what became known as the “kiwi van.”

Finally, we have great memories of the wonderful people who made our year at Boulder so enjoyable, both for me as a scientist, and for us as a family. Best wishes for the celebration.

Sid White

MANY MEMORIES come to mind of an old-timer who spent 12 full summers at Science Lodge, now Mountain Research Station, when requested for a vignette. Some come as questions. Can anyone recall the old Department of Geology Summer Field Camp and its rustic log cabins next to Rainbow Lakes Road about 100 feet from the City of Boulder Watershed Gate? Why was the Megaron so named near Science Lodge where we had classes, meet-

ings, and evening guest lectures? Who cut the blazed trail straight east from Fern Least cabin (#71) next to Como Creek below the old toilets, past the sawmill and through the woods down to Peak-to-Peak Highway 7? Who else was on the 1939 summer faculty at Science Lodge besides Warren O. Thompson, Ernest E. Wahlstrom, and Dewey Sample? Who remembers stripping tops of the tallest pine trees and tying red flags to serve as triangulation points for Doe Thompson's surveying course? Did you know that Ed Kohler, a rancher from near Longmont, ran cattle on Niwot Ridge under a Circle K brand? We met him at Hill's Mill in August 1939 with salt blocks on a packhorse for his cattle. They enjoyed eating the alpine plants alongside their contour trails long before the botanists arrived.

Now for the memories. Remember the Appaloosa Chuck Opperman hired to carry our surveying and camping gear in 1961 from the end of Rainbow Lakes Road along the ridge to Arapaho Pass to start our motion study of Arapaho Rock Glacier; or hitching a jeep ride with John Marr up towards Niwot Ridge to gain altitude into Green Lakes Valley and learning so much from his explanations of botanical phenomena we'd both noticed along the way; or Will Rense predicting at breakfast in the dining hall what the weather was going to be each day; or John Clark leading ten of us on a Sunday morning to the top of Longs Peak; or crawling on hands and knees with Father Macior to photograph his burrowing bees in the ground on Niwot Ridge; or going at twilight with Harold Lutz along the old railroad east of Peak-to-Peak to watch beavers repairing their dam; or an Easter week two-foot-deep snowfall trapping us at Sawmill Trailer, unable to drive out to Nederland and loving every day of the enforced isolation?



Above: Scientists from INSTAAR and the University of Tromsø on R/V Jan Mayen in Kangerlussuaq region, East Greenland, 1996. Photo by katrine Husum.

INSTAAR Photographs



Above: Dining hall at Mountain Research Station, about 1952.

*Below: Philip Miller and Skip Green and a Weasel with snow treads jammed with snow.
Photo by Jim Erdman, 1960.*

FIFTIETH ANNIVERSARY



Above: Tad Pfeffer of INSTAAR conducts an outdoor science class for Nederland Elementary School at Eldora Mountain Resort. Photo by Ken Abbott.

Below: Tundra Lab on Niwot Ridge, constructed in 1990.

INSTAAR Photographs



Above: Alpine Laboratory in 1963.

Below: John W. Marr Alpine Laboratory in 1998.



*Members of the Polar Ice Coring Office (PICO) team extracting an ice core at the GISP2 site, Greenland, 1989.
Photo by Ken Taylor.*



Taking wind profile measurements in Wright Valley, Antarctica. Photo by Karen Lewis.



John Andrews and some former students at Mount Hood, Oregon, 2000. Left to right: Julian Dowdeswell, Julie Brigham-Grette, Peter Clark, John Andrews, Giff Miller, Art Dyke, John England.

INSTAAR's News

Larry W. Anderson

I was at INSTAAR from 1975 to 1976. In 1977, I went to work as a geologist for the geotechnical consulting firm Fugro in southern California. I stayed there until 1980, working primarily on large projects such as nuclear and coal-fired power plants and dam site investigations. In 1980, I moved back to Colorado with my wife Donna, and soon went to work for the U.S. Bureau of Reclamation where I remain today. In my 20 years at Reclamation, I have concentrated on seismic hazard and fault activity investigations for dams and dam sites throughout the western U.S., as well as working on fault and earthquake studies for the Yucca Mountain nuclear waste storage project in southern Nevada.

Lysanna Anderson

I am living in Montana, in the northwest part of the state. When I moved here I started a business ranching, and that has been the focal point of my life since. About a year after I moved here (three years ago) I met a wonderful man, Jack Fitzpatrick, and we have been working together since. We will be married this spring (2001) on our ranch. We have about 2,000 acres and about 200 Black Angus cows (along with horses, cow dogs—and my Kalub—chickens, cats, etc.). We are just finishing our new house and are in the middle of calving.

My most significant accomplishment has been to have the courage to discover this life. I have three stepchildren. I am a wife and partner. I manage all the finances for the ranch and do half the work outside. And I teach at the local school as a tutor and for some of our home-schooled neighbor kids.

I am grateful for my training at INSTAAR. You never know what life is preparing you for. I use my experiences and education every day in managing the ranch, both in terms of the finances and the living system that we depend on for our likelihood.

Stephanie Baker Mead

Stephanie Baker Mead passed away at age 41 on February 6, 2000. She was born in Roanoke, and grew up in Lynchburg, Virginia. She attended the University of Oklahoma and received her Master's degree in geology from University of Colorado, where she met her husband Roy. After working for the EPA in Seattle, she had the courage to follow her heart and change careers, becoming a dedicated and devoted teacher of English to immigrants and refugees at Seattle Central Community College. She enjoyed making music, traveling to experience foreign cultures, seeing historic places, and of course, spending time with her dear friends. Near the end of her life she once again showed her spirit and enthusiasm for life in becoming active again after suffering a stroke. She is survived by her husband, parents, brother, many dear friends, and her cat Grover.

Carl M. Berkowitz

Since leaving Boulder, I've pursued a career in atmospheric physics and chemistry. I now work at Pacific Northwest National Laboratory, one of the Department of Energy research laboratories.

I first worked (hardly an appropriate word, considering how much fun I had) at INSTAAR on a NSF summer student program during the summers of 1968 and 1969 (I think), and pos-

sibly 1970. My first two years were spent studying krummholz growth patterns with Prof. Marr, and then spending a wonderful summer looking for effects of cloud seeding around Lake George, Colorado, on a BLM contract with Prof. Webber. My time at INSTAAR had a significant influence on both my personal and professional life.

Julie Brigham-Grette

Post-doctoral research fellow, Department of Quaternary Geology, Geomorphology, and Marine Geology, University of Bergen, Norway, November 1983–December 1984.

Post-doctoral research fellow, Department of Geology, University of Alberta, Edmonton, Alberta, and Geological Survey of Canada, May 1985–May 1987.

Assistant professor of glacial geology, Department of Geology and Geography, University of Massachusetts, Amherst, September, 1987–1993.

Visiting professor, Alaska Quaternary Center, University of Alaska Museum, Fairbanks, Alaska, January–June 1990.

Associate professor of glacial geology, Department of Geology and Geography, University of Massachusetts, Amherst, September, 1993 to present.

Associate department head of geosciences, University of Massachusetts, Amherst, September, 1998 to present.

Acting department head of geosciences, University of Massachusetts, Amherst, September, 2000–2001.

I have also served on several professional society boards and national panels.

Jane Bunin

I received a Ph.D. under John Marr in 1975. I took various classes at INSTAAR while in my graduate program.

Currently (since 1983) I am president of Natural Science Associates, Inc., Boulder, Colorado, a small ecological consulting firm. Currently (since 1992) I am also senior adjunct faculty in Environmental Studies Department of Naropa University, Boulder, Colorado.

Jeffrey D. Colby

I was a doctorate student of Nel Caine, and currently, I am an assistant professor at East Carolina University in the Department of Geography. One mountain related highlight I have had since departing CU was participating in the International Expedition to the Hindu Kush, Northern Pakistan, in 1999.

Alexis Conley

Graduate degree: M.A., 1997 (as Alexis Hartz) advisor: Tim Seastedt

Since 1997: project scientist for an ecological study in Siberia. I work for Science Systems and Applications, Inc. in the biospheric sciences branch at the NASA Goddard Space Flight Center.

William Richard (Dick) Cowan

Resident 1970–1972, Ph.D. 1975

Since leaving INSTAAR in 1972, I have had an interesting time doing various things. From 1973 to 1979, I was supervisor of Quaternary geology for the Ontario Geological Survey (Toronto), which required me to map Quaternary materials, supervise several other geologists, and review their publications. In 1979, I moved to Calgary to work as a terrain specialist on regulatory matters for the Canadian sector of the Alaska Highway Gas Pipeline. This

pipeline was not completed due to the gas surplus which developed; however, it is now under discussion for future construction to meet U.S. energy needs. These were interesting times with field excursions from Prudhoe Bay, Alaska to Montana through Canada—a great learning experience. In 1981, I recognized that the pipeline was not going anywhere slowly and entered the private sector as an environmental manager with Techman Engineers Ltd. in Calgary, where I worked with a team of environmental specialists doing environmental assessments and regulatory matters on coal mines, pipelines, and oil sands projects. In 1983, the economy went for a tumble, and I started my own company, Palliser Consultants Limited, which carried our environmental assessments, surficial geology, and energy related projects. I did this until 1987 when I returned to Toronto to work with the Ontario Geological Survey again. I had only been there four months when I was appointed manager of mining lands, responsible for mineral dispositions and management for Ontario, a province with present mining production of about U.S. \$4 billion. I subsequently became manager of mineral development (1990) and director of the mining and lands management branch (1993), responsible for mining lands, mineral development, and mine rehabilitation throughout Ontario (one million km²). I currently am mainly involved with my statutory role as director of mine rehabilitation, which focuses on ensuring that new mines come into production with mine closure plans in place that are secured financially in the event of default. As well, a similar program is in place for existing mines, and we are currently working on a four-year \$27 million program to rehabilitate our numerous abandoned mines.

During my career, I believe I made significant contributions to our knowledge of the Quaternary geology of Ontario; I consider my work as a mapper/scientist was probably the part of my career that was the most fun

and perhaps most productive doing original work. Over the last ten years I have been focussed on activities related to sustainable mining in Ontario and Canada and I hope I have made a positive contribution. As well, my youngest of four children just left the nest and that part of my career, perhaps the hardest, is slowed. I have been strongly supported in my career by my wife of 34 years and my children who were always willing to move homes to meet my career aspirations.

To conclude, the eclectic training and experiences I received through my association with INSTAAR and my colleagues there made me into a flexible person with diverse interests who could cope with a variety of challenges in a positive way. This has been a great benefit both to myself and to the people/organizations I have worked with and for. Congratulations INSTAAR on your successes.

Wendy (Cunningham) Littman

I got my masters at INSTAAR in 1997.

- Worked for one year as a PRA for John Andrews, continuing some of my masters research.
- Worked for one year at the Geological Society of America as a program manager in their Science and Outreach department. Basically, I was helping to facilitate communication between geoscientists and the public.
- Since April 2001, I've been working as a science writer, creating Web sites to help the DOE's Office of Energy Efficiency and Renewable Energy communicate the latest renewable energy research to the public.

Leland (Lee) R. Dexter

I was at INSTAAR from 1982 to 1986. Upon graduation in 1986, I took a one-year temporary instructor position in the Geography Department at Northern Arizona University, Flagstaff, Arizona. In 1986–87, I was hired to a tenure track position in geography at California State University at San Bernardino, where I spent two years (1987–89).

I was hired to a tenure track position at Northern Arizona University in 1989 where I am currently an associate professor of geography.

John C. Dixon

I received my Ph.D. in geography at INSTAAR in 1983 and my dissertation title was “Chemical weathering of late Quaternary Cirque Deposits in the Colorado Front Range.” This research was conducted in Arapaho Cirque and in Caribou Lake Cirque on the west side of the Divide. Upon graduation (actually a couple of years before graduation), I was hired into a position in the Geography Department at the University of Arkansas at Fayetteville (the State Land Grant Institution). I have been there ever since, and a year ago was promoted to the rank of professor. Between 1993 and 1998 I was chairman of the Department. My research interests continue to be primarily focused on geochemical processes in landscape development in Arctic-alpine environments. I have continued to do research in the Front Range as well as in S.E. Alaska. For the past eight years I have been working in a research group in the Scandes Mountains of Swedish Lapland looking at landscape geochemical processes.

This work has been supported by funds from The National Geographic Society and from the National Science Foundation. In addition, we have similar work underway in the Jotunheimen Mountains of southern Norway. In addition to my work in Scandinavia, I have been working with anthropologists from Alaska on the historical

development of subsistence based Eskimo societies and their responses to environmental change. This work has been supported by NSF's Office of Polar Programs. The research findings of our Scandinavian research team have been widely published in international journals of geomorphology and soil science. I trust this brief biographical sketch contributes in a small way to successful celebrations of INSTAAR's 50th.

James J. Ebersole

Ph.D. 1985. I am now in my 14th year teaching at Colorado College in Colorado Springs, a nationally recognized undergraduate liberal arts school. In addition to teaching courses in botany, ecology, and biostatistics, I have published a number of papers with undergraduate coauthors on subjects ranging from ecophysiology to restoration ecology. Fifteen years after my graduate field work, I revisited my Alaskan dissertation study sites and co-authored a paper offering a circumpolar comparison of arctic vegetation recovery in Alaska, Canada, Greenland, and northeast Siberia. My current research focuses on restoration ecology in the Colorado alpine.

Margaret M. Eccles

I want to let people know that I remember my INSTAAR years with great fondness and still think it was the best place I ever worked. Everything I do these days involves security clearances, and that really takes away a lot of the fun. I enjoyed what I was working with, too; the sciences interest me, and I liked what I was working with.

Jim Erdman

Current Volunteer Efforts

Serving on steering committees of two land trusts: the Crestone/Baca Land Trust, which received a \$129,000 wetland-purchasing grant from Great Outdoors Colorado in July 2000; and the Rio Grande Headwaters Land Trust. Also member of an ad hoc Governance-Research committee on pros and cons of the Baca Grande subdivision becoming a municipality. Worked with the Bureau of Land Management on its Gunnison Sage Grouse vegetation surveys in the Mountain Big Sagebrush terrain at the north end of the San Luis Valley.

Professional Accomplishments

- I have done contract work with Water Resources Division, USGS, to delineate subsurface leachate plume from Norman landfill, central Oklahoma, using biogeochemical sampling. A report, "Elements in Cottonwood Trees as an Indicator of Ground Water Contaminated by Landfill Leachate," by Erdman and Christenson, was completed January 1998, and published in the winter 2000 issue of the journal, *Ground Water Monitoring and Remediation*.
- I have worked with multidisciplinary and interagency teams on complex projects such as the politically delicate impact from the Summitville Mine contamination of irrigation waters on the nutritional quality of a major crop, alfalfa, in the San Luis Valley, Colorado. In 1995 received Special Act Award from the USGS for outstanding work, yet forced into retirement in '96.
- My experience in "reading the landscape," blending plant patterns with geology (landforms, structure, hydrothermal alteration), led to a multi-year collaboration in the early 1990s with the U.S. Forest Service in the Tobacco Root Mountains, western Montana, dealing with its Ecosystem Management Program.

- I have published 100 papers and 35 abstracts; in 1985, was nominated for Distinguished Lecturer in the Association of Exploration Geochemists; served on manuscript review committee, and reviewed 35 fact sheets (outreach documents for public information).
- I have received international recognition as an exploration biogeochemist, especially after publishing a pivotal journal article about the use of plants in gold exploration, and have prior experience in uranium and porphyry copper exploration.

Professional Experience

Consultant, USGS/Water Resources Division, Oklahoma City, Oklahoma, 1997–1998; scientist emeritus (retired), Central Region Mineral Resources Team U.S. Geological Survey, Denver, Colorado, 1996–present; botanist, environmental geochemistry section, branch of geochemistry U.S. Geological Survey, Denver, Colorado, 1967–1996; Expertise in environmental geochemistry, designing sampling plans to assess impacts of point-source contamination; Diverse experience in integrating the element analysis of plant tissue (biogeochemistry) with the distribution of indicator plants (geobotany) to aid in mineral and geothermal exploration in a wide range of landscapes from Sonora, Mexico, to the central Aleutian Islands.

Rick Ernst

I worked for Dr. Giff Miller in the Amino Acid Geochronology Laboratory at INSTAAR from 1985 through 1987, then in the summers of 1988 and 1989. Although it started out as a summer job, I became involved in my work, and with Giff's help and direction, became involved and performed research work which led to undergraduate research grant, an Honors thesis (graduated from CU in 1987, *summa cum laude*), and my

Master's thesis (I graduated from the University of Arizona/Tucson in December 1989; Giff was on my committee; I did all my lab work at INSTAAR; my thesis was titled "Reaction Kinetics of Protein Hydrolysis, Amino Acid Decomposition, and Isoleucine Epimerization in Eggshell of the African Ostrich, *Struthio camelus*").

Barry Fahey

I graduated with a Ph.D. in geography in 1971. I journeyed from New Zealand to Boulder to begin studies towards a Ph.D. in the Geography Department in 1965. After completing most of my course work by 1967 I still hadn't decided on a dissertation topic. However, about that time Jack Ives was appointed Director of INSTAAR. He had plenty of great research ideas, and before long I was working on a topic dealing with periglacial processes and landform development in the Front Range.

In 1970 I took up the position of assistant professor in the Geography Department at the University of Guelph in Ontario, Canada. I returned to Boulder in the summer of that year to defend my thesis, and to teach the Mountain Geomorphology course at the Mountain Research Station. I remained at Guelph for the next 15 years teaching a variety of courses from first year to the graduate level, mostly in geomorphology. I also continued with my research interests, notably in assessing the relative importance of freeze-thaw, hydration, and salt weathering processes in periglacial environments under simulated conditions in the laboratory. These experiments were supplemented by field studies during the Ontario winters. I also spent a summer with a colleague from Guelph on Broughton Island in the eastern Canadian Arctic, studying the microclimate of the Arctic tundra. In 1976 I took a sabbatical leave back in New Zealand in the Geography Department at Otago University, where I investigated the age and origin of the

upland schist tors of the Central Otago block mountains. I was promoted to associate professor at Guelph in 1981.

Although I enjoyed my time at Guelph, it was always our intention to return permanently to New Zealand. This opportunity arose when I was back there again on leave in 1984. I visited the Forest Protection Division of Forest Research Institute (FRI) on the University of Canterbury campus in Christchurch that year and talked with its director about my interest in returning. He was looking for someone with a background in geomorphology and hydrology to establish a research programme on forest road erosion in New Zealand steep-land forests, and I convinced him I was the person for the job. I joined FRI in September 1985, about ten days before the government decided to disband its umbrella organization, the New Zealand Forest Service. For the next ten years it was one round of restructuring after another. However, my association with FRI rekindled my pre-Ph.D. interests in land-use hydrology. Thus, in the ensuing years I found myself investigating the impacts of afforestation and harvesting on water yield, sediment yield, and water chemistry.

In 1992 the government restructuring of science in New Zealand culminated in the establishment of nine Crown (i.e., government) Research Institutes or CRIs. The group I worked for in FRI was merged with one of the new CRIs called Landcare Research, which is responsible for providing information to the government and other clients on the status of terrestrial ecosystems. I am based at Lincoln, about 20 km south of Christchurch near Lincoln University, one of the two main agricultural universities in the country. I work for the Catchment and Biophysical Processes Team.

Despite most of my research now being conducted in temperate environments, my interests in periglacial landforms and processes are still catered for through a Landcare-based teaching contract I have with

the University of Canterbury. For the last eight years I have taught a graduate course in the Geography Department on Quaternary Environments and Periglacial Processes, which provides me with the incentive to keep in touch with recent advances in the field. Each year I take the class on a field trip to the St. Mary's Range just inland from Oamaru on the east coast of the South Island. The area resembles Niwot Ridge in many respects with its variety of periglacial landforms, including patterned ground, tors, block fields, solifluction lobes and nivation hollows. On the way back to Christchurch we look at the sequence of glacial landforms left as a legacy of Pleistocene Glaciations in the Mt. Cook area. In the past few years I have also prepared a number of contract reports for the New Zealand Department of Conservation on the impacts of snow grooming on vegetation and soils at one of New Zealand's main ski fields in the west Otago mountains.

As for my main accomplishments I have over 50 refereed papers in print, and half-a-dozen chapters in books, as well as numerous contract reports for Landcare clients. I was recently given the honorary title of Senior Fellow in the Geography Department at the University of Canterbury, and last year I was awarded the New Zealand Hydrological Society's medal for outstanding achievement in the science of hydrology. I was on the Executive Committee of the Society for eight years, and was secretary for four years. In addition I have just stepped down after five years as leader of the Working Group in Forest Hydrology for the International Union of Forestry Research Organisations (IUFRO) based in Vienna.

My research and teaching career is now drawing to a close, and this year I have gone on to reduced hours, with a view towards retirement in a couple of years' time. One of my lasting memories of Colorado, however, is of summer fieldwork on Niwot Ridge with all its color and atmospheric clarity, and

watching the build-up of cumulo-nimbus clouds along the Front Range as a prelude to the afternoon thunderstorms.

I am proud to have been associated with INSTAAR when I was a student there in the late 1960s, and I wish the Institute every success in the next 50 years.

Sid Gustafson

I was the first maintenance supervisor sent up to the John Marr lab from the University of Colorado Facilities Management. During that time the Mountain Research Station was in really bad shape ... so I videotaped all the problems, called Risk Management and Environmental Health and Safety up to the station, and showed them the videotape that I made. When I left, I also made a record of the entire station and all of its needs at the time. I still have a copy of that also.

As project manager I had responsibility for the planning budgeting and construction of the new John Marr lab and the Kiowa lab renovation—a \$250,000 project over which I had control. I brought the project in on time and on budget.

I'm currently the head instructor of the University Colorado's physics trades teaching laboratory. This facility teaches the entire University community machine shop technology and welding practice. About 200 students a year attend these courses. I've had many INSTAAR professors or researchers here taking my classes.

Kathy Hansen

Since leaving INSTAAR, I have become a full professor of geography in the Department of Earth Sciences at Montana State University, Bozeman. My most significant accomplishments include that I continue to study mountain environments (treeline, snow, and climate). I initiated and developed the Center for High Elevation Studies at Montana State University. I have had numerous graduate students of whom I am very proud, and I still love to hike, ski, and play in mountains.

Dexter W. Hess

I arrived in Boulder in the fall of 1953, having just completed my M.S. under Dr. Oosting of Duke University. He had suggested that I continue my studies under Dr. Marr at the University of Colorado because of my interest in microclimate and the ecology of trees. And so I spent the next six years with the Institute, servicing the weather stations and assembling climatic records while I worked toward my Ph.D. I was a southerner and so chose to do my research as low in elevation as possible in the ponderosa pine zone near station A-1 and Sugarloaf Mountain. I was also told that one of the skills I need to learn was either skiing or snowshoeing—I opted for snowshoes.

I completed typing my thesis on the Cambial growth of Ponderosa Pine during the summer of 1959 while living with my family at Science Lodge. Two of my most vivid memories of that summer were, enduring the hundreds of miller moths that fluttered around my typewriter each evening putting punctuation marks where none were intended, and spending weeks trying to dislodge a pack rat that had decided to live in the frame of our family automobile.

During the weeks just prior to receiving my degree I had applied both for a research grant and also for a teaching position, hoping that one or the other would materialize. The

grant did not arrive but the teaching job did. On such a happenstance event does a lifelong career depend. I rented a truck and moved family and belongings to La Junta, Colorado, where I had been offered a position teaching botany at Otero Community College. My wife and I planned on staying in La Junta for ten years and then moving on. That was 42 years ago and we are still here.

I came to Otero to teach botany, but at a small college you find that you will need to do many things. I taught botany until it was merged with zoology into general biology. After that, my major teaching topics were plant taxonomy and microbiology. During the summers, especially early in my career, I taught plant ecology courses at the University of Colorado, Denver University, and the University of Northern Colorado.

Later, I spent many summers participating in workshops on ecology, threatened and endangered plant species, radiation biology, desert biology, and noxious weeds.

The principal reason I remained at Otero for so many years was that I had an excellent college president (Dr. William McDivitt) to work under, and I was given free rein to teach and develop quality science courses that would transfer to any university. I became chairperson of the Biology Department in 1962, was promoted to chair the Science Department in 1972, and in 1977 I became the dean of faculty, a position I held until I retired from the college in 1983.

Almost immediately, I entered the world of business and industry. I was asked to join the staff of Western Foods, a local food processing plant (pickles and tomatoes), as head of the quality control department. I spent the next four and a half years experiencing how industry deals with its problems, and it is quite different from academia. I retired from the company in 1987.

That same summer I became a seasonal ranger for the National Park Service, and on an intermittent but continuing basis have

served as a park ranger to the present. I do both Living History role playing as well as historical plant research at Bent's Old Fort National Historic Site near La Junta. Interspersed with my work with the Park Service, I have served as consultant for our local Head Start program and developed a science course for pre-school children and their teachers; and served as tour guide for the U.S. Forest Service Dinosaur Trackway in Pinyon Canyon and have prepared a illustrated wildflower guide for visitors.

Most of my current research interests are small projects dealing with the historical changes in the vegetation of the lower Arkansas Valley. In the summer I teach a local wildflower course, and am active in the Colorado Native Plant Society. Otherwise, I keep busy with community involvement such as serving on our local hospital's Ethics Committee and working with Hospice patients who are terminally ill.

Albert W. Johnson

Joined the Institute of Arctic and Alpine Ecology in July 1951, and continued until September, 1954. Received a Ph.D. in biology (plant ecology) from the University of Colorado under John W. Marr in 1956. From 1956 to 1960 was on the faculty of the University of Alaska in biology. In 1960–1961 was in Norway on an NSF Science Faculty Fellowship. In 1961–1962 re-joined the University of Alaska faculty. From 1962 to 1964 was at UCLA doing research. From 1964 to 1969 was on the faculty (biology) at San Diego State University. From 1969–1977 I was dean of the College of Sciences at SDSU. From 1977–1991 I was vice-president for Academic Affairs at SDSU and retired in 1991. Research in Alaska from 1956 to 1977, mostly at Cape Thompson in northwest Alaska.

Owen A. (Al) Knorr

I was a research associate with the IAAR from 1951 to 1956. My work was primarily to assist in the collection of data from the sixteen original environment measurement stations.

During this period John Marr became concerned with a certain lack of precision with which the data were being collected. Since I had some experience in writing manuals for the Army and the Air Force, he asked me to write a "Servicer's Manual" and I produced an eight-page document which was used to train new personnel.

John also asked me to do the maps, vertical profile, and the graphics for the *Climatic Atlas* which was Part V of the overall IAAR report entitled *Vegetation and Environment on the East Slope of the Front Range in Colorado*.

Finally, I participated in the production of the final report *Data on Mountain Environments II—Front Range, Colorado—Four Climax Regions, 1953–1958*.

I thought I had retired from doing biological assessment and environmental impact studies, but my friend (?) Professor William A. Weber referred the international environmental artists Christo and Jeanne-Claude to me, and in September I will be doing an environmental analysis of their project to cover (literally) several miles of the Arkansas River.

H. Robert Krear

I do not remember when I started working with IAAR—perhaps 1960. I was a member of the team that serviced the meteorological stations, especially in the winter. During World War II, I served with America's only alpine infantry division (The 10th Mountain Division), so it was a pleasure for me to be reintroduced to the army over-snow vehicle known as the Weasel that my mountain division had created during the war, and which IAAR was using to service the stations on Niwot Ridge.

I also used this vehicle on weekends during three winter seasons to conduct my doctoral research in the Niwot Ridge area dealing with the behavioral and ecological study of the pika (*Ochotona princeps*). It would have been more difficult to conduct this research during winter conditions without the aid of this vehicle, and I was very grateful to the Institute for making it available to me.

I completed my doctoral program in the spring of 1965, and my dissertation "An Ecological and Ethological Study of the Pika (*Ochotona princeps saxatilis* Bangs) in the Front Range of Colorado" received the Phi Sigma Outstanding Graduate Student Award that spring. I gave a copy of it to the Institute.

During graduate work at CU, I taught with the General Biology Program as a teaching fellow and full time instructor, and as a visiting lecturer in zoology. After graduation I taught at three universities (1) Mankato State University, Minnesota, (2) The Colorado Alpine College of United States International University, and (3) Michigan Technological University, retiring in the spring of 1984.

I consider my major career accomplishments to be four arctic and subarctic research expeditions:

1. The Osborne Ungava Ecological Expedition (1951)
(Studies in subarctic northern Quebec and Labrador)
2. Fur seal research, Pribilof Islands in Bering Sea—USFWS (1953)
(Worked out the reproductive cycle of the cow fur seal)
3. Member of the Olaus Murie 1956 Arctic Brooks Range Expedition
(Conducted research that contributed largely to the creation of the National Arctic Wildlife Refuge in northeast Alaska)
4. Sea otter research, Amchitka Island, western Aleutians (1957)

(Six months studies, summer, fall, and winter, determining methods of keeping otters alive in captivity, and of reestablishing such otter populations in areas of their former range from which they had been exterminated.)

In addition, I served as a seasonal professional naturalist in eight major national parks over a period of 15 years. I was also a member of the Mountain Rescue Team in Grand Teton National Park. One rescue, performed under extremely dangerous conditions on the Grand Teton, received the U.S. Department of the Interior Valor Award.

M. Iggy Litaor

Shalom

The following are a few lines describing my activity since leaving INSTAAR 1990.

09/90–06/95: senior geoscientist, EG&G Rocky Flats Environmental & Technology Site, Colorado. Lead scientist of the Environmental Restoration Division's Soil Science Team. The main task of my team was to conduct a comprehensive site assessment of contaminants in the vadose zone and the soil environs. More specifically, I studied the nature and extent and the fate and transport of actinides in the soil environment around Rocky Flats Plant. This work entailed extensive stochastic modeling and geostatistics to provide spatial estimation, uncertainty maps, and additional sampling strategies of contaminants in soils around Rocky Flats Plant.

07/93–1997: associate professor adjunct, Department of Civil and Environmental Engineering, University of Colorado, Boulder, Colorado. Studied the fate and transport of actinides in the soils of Rocky Flats Plant. Designed and installed a state-of-art remotely controlled real-time in-situ monitoring system (MS). Conducted a detailed study of macropore flow and its role in contaminant transport

under controlled rain simulations, snowmelt and natural rainfall. The hydro-geochemical and mineralogical characteristics of the contaminants (i.e., particle, colloidal, and dissolved) were studied in great details. Supervised five graduate students.

The above mentioned work produced over 15 journal articles on the fate and transport of actinides in the soil environs.

08/96–present: associate professor, Department of Biotechnology and Environmental Sciences, Tel-Hai Academic College, Upper Galilee, Israel. Teaching several courses in environmental sciences. Current research interests: the hydro-geochemistry of altered wetlands and the regional effects of global climate change. Supervising five graduate students who are working on the hydro-geochemistry of nutrients in altered semi-arid wetland ecosystem.

Darvel Lloyd

I was a graduate student in geography at the University of Colorado in Boulder and was involved with INSTAAR from 1968 to 1970, graduating with an M.A. in Geography in 1970. My thesis was “The Isabelle Glacier, Front Range, Colorado During the 1968–1969 Budget Year.” My thesis advisors were Dr. Roger Barry and Dr. John Andrews.

J. Michael McKenna

I have fond memories of my work on the response gardens with Dr. William S. Osburn during the summers of 1961 through 1965. We established four of these gardens at different elevations—one right above the Mountain Research Station, one at the end of Niwot Ridge, and two at lower elevations. Then, we transplanted several different species of plants from each elevation to each of the other elevations, and carefully moni-

tored their growth. It was fascinating to separate out the longer term genetic effects and acclimatization effects from the shorter term growth effects on individual plants.

After my Science Lodge days, I got my Ph.D. degree in Organic Chemistry from the University of Wisconsin in 1970, and went to work for DuPont in Wilmington, Delaware. I have been instrumental in developing a new class of thermoplastic elastomers, which are now used around the world—primarily in automotive applications (covers for the airbags, continuous velocity joints), but also in a large number of other applications (tubing, film applications for breathable jackets, seating, fiber applications, small molded parts, etc.). I have a number of patents and publications in addition to my commercial successes.

Gerald A. Meehl

Since leaving INSTAAR as a master's degree student studying tropical connections to the North Atlantic Oscillation, I have been working at the National Center for Atmospheric Research, first as an associate scientist and then as a research scientist. My research has focused on two major areas. The first is diagnostic studies of the coupled climate system utilizing analyses of observations and model simulations, and the second is analyses of future climate simulations from a hierarchy of climate models. My roots are in field experiments from my grad school days during the 1970s when I collected data during the Tropical Wind Energetics Reference Level Experiment (TWERLE) and Monsoon Experiment (MONEX) in the tropical Pacific/Asian-Australian monsoon regions. During these field experiments I not only became familiar with observed data, but witnessed the workings of the climate system in those regions firsthand. These experiences motivated my Ph.D. thesis at CU. In it I documented the fundamental workings of what I would later name the “tro-

pospheric biennial oscillation" (TBO). Due in part to my work in this area, the TBO is now a mainstream area of monsoon research as recognized by CLIVAR in the recent "Implementation Plan for CLIVAR Asian-Australian Monsoon Research" and typified by a special session on the TBO in the Eighth Scientific Assembly of IAMAS in Innsbruck, Austria.

Though my research interests are wide ranging, a common thread is time and space scale interactions. These include synoptic/subseasonal/MJO, seasonal, TBO/ENSO, global decadal variability, and climate variability related to low frequency external forcing. These interests in scale interactions led me to get involved in TOGA COARE, a field project to study coupled interactions in the western Pacific warm pool region in the early 1990s. I was a co-PI on a TOGA COARE grant with another former INSTAAR person, George Kiladis, and was active in the site survey, deployment, data collection, and analysis of data from the Integrated Sounding Systems (portable weather stations) developed at NCAR.

My other major area of research is climate change. For example, in recent work I have demonstrated that cloud feedbacks operating in the equatorial Pacific can contribute to initiating the coupled processes that produce an "El Niño-like response" to increasing CO₂ in some global climate models. This response, with greater relative warming of sea surface temperatures in the eastern compared to the western equatorial Pacific, is significant in its possible future consequences for water resources in countries in the Asia-Pacific region. I have been active in the international climate change research community, serving on various committees and contributing to the IPCC climate change assessments, most recently as a convening lead author of the chapter on future climate change for the upcoming IPCC Third Assessment Report. It is interesting that my initial connection to INSTAAR, an institute dedicated to alpine and polar re-

search, was studying the tropical link to the North Atlantic Oscillation with Roger Barry, David Greenland, and Harry van Loon from NCAR. That evolved to more work focusing on the tropics and led to research in climate change. However, I have maintained my interest in high latitude processes, and I have published a number of papers on climate variability and climate change related to cold regions in both hemispheres.

Mark D. Moorhead

I graduated in 1999 with a Ph.D. in geophysics.

I am presently working on a post-doctoral position at Northwest Watershed Research Center, which is an Agricultural Research Service laboratory in the U.S. Department of Agriculture. We are studying the conditions leading to large winter flooding events in the Pacific Northwest.

I am presently applying for positions at various universities.

Ann Marie Odasz

I was Dr. John Marr's last Ph.D. student and graduated from CU in 1983. I did my research in the Brooks Range of Alaska on vegetation at the treelimit.

I went to Norway to post-doc with Dr. Eilif Dahl at the Agricultural University of Norway. Eilif had been on a sabbatical with Dr. Marr in 1954 and hiked the treelimit of the Rockies. What wonderful people both these men were. My post-doc was a NSF one year grant ... but I got a permanent job (no tenure endurance test over in Norway!) and I've been a professor at the University of Tromsø—world's northernmost university—ever since. Most of my work has been conducted on Svalbard with long seasons looking at population dynamics of arctic plants and recently on plant-reindeer interactions. The generous sabbatical system in Norway has let me maintain working rela-

tionships and friendships in Boulder, and I'm presently on a research visit from the Department of Arctic Biology in Tromsø.

I have advised 13 graduate students and many of them are running research programs of their own in northern Norway and on Svalbard.

Bill Osburn

Though I left INSTAAR in the fall of 1965 after 14 years, it did not mean a severing of ties. For the next 32 years most of my activities would have a strong association with my research years on Niwot Ridge, particularly regarding the value and need for such sites in resolving environmental issues. As an associate professor in the Department of Radiation Biology at Colorado State University (65-66) I continued to collect, analyze and prepare for publication data from Niwot Ridge.

In June 1966 I accepted a position as ecologist with the Atomic Energy Commission. As a condition of employment my job description required that I keep abreast of developments in ecology and associated fields, and focus on pertinent environmental issues. I was to become familiar with individuals and their research sites, carrying out ecological studies in all major ecological regions, particularly Arctic-Alpine, or wherever ionizing radiation could become an issue. As one senator put it, my hobbyhorse and workhorse was the same. At this time the AEC was funding more ecological/field research than any other agency, including the National Science Foundation, and I became a focal point for evaluating much of this funding.

My position label was technical representative for ecological/environmental research. I was to encourage submission of proposals, to have them peer-reviewed, to prepare an evaluation summary, establish scientific merit and appropriateness of agency funding, and finally to present them to a multi-disciplined panel of scientists for fund-

ing approval. I was also able to develop special areas of research such as an Arctic program, environmental health and indicator programs, and a National Environmental Research Park (NERP) program.

My path repeatedly crossed with INSTAAR. One major path concerned supporting research proposals of their scientists. In general it was a pleasure to defend the typically well-prepared, innovative, and fully justified research proposals from INSTAAR members and/or alumni, which over the years included Drs. Clifford Amundson, Nel Caine, Jack Ives, Albert Johnson, Norman French, David Gates, Philip Miller, David and Barbara Murray, Dean Smith, Skip Walker, Patrick Webber, and William Weber.

My work flexibility initially was large, though it decreased, as the AEC became an Administration and finally a Department becoming increasingly political and rigid. I was permitted to keep relationships established while an INSTAAR member such as those with Time-Life, the Conservation Foundation, National Academy of Science committees, and with the Aspen Institute's Seminar of Environmental Arts and Sciences. Occasionally I substituted for the Commission Chairman, Dr. Glen Seaborg, concerning environmental issues such as nuclear testing on Amchitka rather than in the coastal region of northern Alaska.

Not only was I encouraged to develop research programs but to participate in a wide array of interagency environmental activities. This was during a period that environmental awareness and intense activism was rapidly developing, especially after the National Environmental Policy Act of 1969 (NEPA) was passed and Judge Skilly Wright wrote his precedent-setting opinion that NEPA gave every Federal agency a second mission and of importance equal to that of their present mission.

My agency along with most others responded to this opinion and to public insis-

tence and increased environmental/ecological consideration dramatically. Consequently, I was placed on many interagency environmental/ecological committees, was invited to numerous workshops, conferences (from local garden clubs to international organizations), requested to write “white papers,” position papers, responses to citizens, and provide frequent congressional or budgetary testimony. Among the many position papers or reports I helped prepare the one I most enjoyed, and which received much attention, concerned the value of the Navy Arctic Research Laboratory and its role regarding setting of environmental regulations. This report argued that most environmental regulations—especially in the Arctic—are based on little scientific information, consequently they are often overly constrictive or too lax. In either case, they may be costly: If overly constrictive, the economic cost is unnecessarily large; if too lax, the environmental cost may be very large.

Thus, new environmental regulations should be promulgated jointly with a research program. This would allow the regulation to be adjusted as data are gathered. The concept was warmly received by the 1977 Committee on Science and Technology (U.S. House of Representatives). Though nothing came of the “happy reception” the concept remains valid and perhaps will be picked up—persistence is often a key to Federal action.

As program chairman for the Ecological Society of America I developed a special panel for the First Annual Biological Congress, wherein major Federal agencies reported their planned response to NEPA only four months after its signing. John Dingle, a coauthor of NEPA described the session as “music to my ears” and stated he would hold a similar meeting that fall to evaluate the environmental sincerity of the respective agencies. This led to a very contentious hearing series—it seems many agencies thought they

were exempt from NEPA. But these hearings surely shortened the learning curve for many agencies, and their resistance to NEPA compliance was dramatically altered—and their environmental programs were substantially increased.

While with the Federal government, I continued to organize and write up the results of my INSTAAR research. Throughout my entire Federal career substantial amounts of these data were used in a wide range of activities including lectures such as the special congressional lecture series, the Smithsonian Winter Lectures, briefings to the Office of Congressional Research Services, the Woodrow Wilson Foundation for Scholars, the United Nations energy/environmental meetings, etc., and numerous “environmentally aware” civic organizations as well as secondary schools and universities.

INSTAAR research information was especially useful in my early years with the AEC when nuclear warfare was a much-discussed issue. In fact this was the major issue within the Office of Civil Defense and they needed a definitive position. The National Academy of Science was asked in 1967–68 to evaluate the effects of a nuclear exchange, partial and all-out, both short term and long term. Not only was INSTAAR research information used in the first two reports, but largely because of these INSTAAR studies, I was asked to author the ecology chapter in the final report: “Forecasting Long Range Recovery from Nuclear Attack”.

Other National Academy activity included serving as a delegate to several international congresses and, ironically to review the research program of the same Army Quarter Master Corps division that provided support for the first three years of INSTAAR. Also included in this review was the research of Dr. Dansereau who gave the keynote speech dedicating the Alpine Laboratory at Science Lodge in 1963.

Perhaps my most notable post-INSTAAR achievement concerned the development of a system of National Environmental Research Parks (NERPs). A National Environmental Research Park is an outdoor laboratory wherein research may be carried out to achieve agency and national environmental goals as articulated in the National Environmental Policy Act (NEPA). Simplified, these goals indicate the nation's task is to understand our environment sufficiently so that we may enjoy its bounty and its beauty without detracting from its value and eventually evolve an equilibrium use of our national resources.

The Department of Energy (DOE) has stewardship for lands representing a large array of the nation's ecological regions, a correspondingly large array of environmental disrupting activities are taking place on these lands, that a highly competent cadre of researchers are associated with these sites and by proper organization of environmental research to achieve agency mandated goals we can simultaneously aid in resolving environmental problems on-site, locally, regionally, nationally, and globally. Each research park is dedicated to helping resolve environmental problems of many scales. A charter also outlined specific goals and outlined procedures for these achievements.

The embryo from which this program grew can be traced back to the INSTAAR radioecology program of (1959–65). A number of INSTAAR alumni were eventually involved but Mark Paddock supplied a very persuasive comment concerning the value/need for ecological research sites at a field review which led to the crystallization of the research park concept in the fall of 1970. The program was formally established within the AEC, which was later to become the Department of Energy. It was approved by many groups particularly the committee charged by the President's Council for Environmental Quality and the Federal Council

for Science and Technology concerning the role of Ecology in the Federal Government. Furthermore it urged that these research parks form the basis for a National System of Ecological Research Areas. Special hearings of the U.S. House of Representatives Committee on Science and Technology titled Environmental Research Reserve Networks featured (over 100 pages of documentation) these NERPs.

In separate action the National Science Foundation funded a study of a proposed National Network of Experimental Ecological Reserves. These NERPs were included, and area wise contributed more than all other Federal agencies combined. Also, the quality of these sites for research achieved very high rankings. The concept of these research parks was widely used by others interested in ecological reserves this included an invitation by the Canadian National Committee on Problems of the Environment to provide a discussion on the next phase in Northern Ecological Research. (Again the paths of several INSTAAR members and alumni came together—Drs. Les Viereck, Patrick Webber, Phillip Miller, and Bettie Willard.

In "selling" the concept of developing outdoor laboratories (NERPs) major intra-agency resistance centered around the question of how could we assure the public this is a wise expenditure of their tax dollars. I was able to return to INSTAAR days for examples of field research payback. The two examples I most frequently used were as follows.

The Public Service Company of Colorado used information regarding depth of organic soil needed to support moderate plant cover from my research on Niwot Ridge, to justify the rerouting of a gas pipeline over a mountain pass. The revised route had less deleterious environmental impact, and being far shorter, the dollars saved was greater than INSTAAR's total budget

from its initiation to the date of action—some eight years.

The second example concerned the proposed clean up of plutonium-contaminated soil at Rocky Flats. The initial proposal was to remove 4–6 inches of topsoil from many acres (20–40) of the eastern portion of the plant site. Extrapolation of research results from the 1957 to 1964 years of radioecology research (from Niwot Ridge) supported by onsite research of INSTAAR scientists Nel Caine, Harvey Nichols, Patrick Webber, and William Weber was sufficient to convince the operations office that the pattern of plutonium contamination was directly related to snowfield distribution, and that by cleaning a very small but precisely located area the total field contamination was reduced to insignificance. The savings of taxpayer dollars amounted to many millions.

One of the more meaningful outcomes in establishing NERPs was convincing the Federal Council for Science and Technology to accept and sanction the concept that sites reserved for ecological research are actually “land facilities” which should be treated as “unique, unusual and expensive-to-duplicate research facilities” and that these outdoor laboratories were as essential to making good land-use decisions as an “indoor laboratory” is to human health research. This led to a revision of a Presidential Executive order, which directed that land be returned to the Savannah River Reservation for ecological research—specifically to the NERP program.

Another INSTAAR contribution regarded the distribution patterns of nuclear fallout and other contaminants deposited from the atmosphere—the first to find evidence that deposition may follow logarithmic rather than normal scales. The Health and Safety Laboratory, concerned with worldwide ^{90}Sr deposition soon followed suit. In specific ecological situations it is now standard procedure.

My career path repeatedly crossed with and was much influenced by INSTAAR or former INSTAAR members. I seldom attended a major environmental meeting (especially Arctic ones) without interacting with participating INSTAAR members. Whenever my travels brought me back to Colorado I would always visit and exchange information with INSTAAR, not only with present members but those still on campus or nearby—this often included Drs. Bill Bradley, Bill Weber, Horace Quick, and Bettie Willard. Drs. Cliff Amundson and James Erdman were particularly helpful concerning ecological research on Amchitka Island.

Dr. Jack Ives and I interacted on a number of environmental committees and activities, including the International Biome Program. He and Dr. Patrick Webber always responded rapidly and thoughtfully on numerous occasions and helped convey arctic-alpine information to the public. Dr. Albert Johnson, via the National Academy of Science chaired a carefully selected committee and carried out a critical, creative review of the DOE Arctic Research Program and provided useful guidance to form a research program known as R4D. Dr. Ronald Foreman, a valuable, well-organized assistant while at INSTAAR continued ecological interests and eventually directed a field station, but he was always a valuable informal consultant. Dr. Bill Rickard and I were in a near continuous environmental relationship while he was engaged in arid land research at the Nevada Test Site and later when he was recognized as an environmental ombudsman at the Hanford Laboratory. Drs. Gates and Mark Paddock and I exchanged professional visits continuing our INSTAAR association while they were at the Missouri Botanical Garden and at the Michigan Biological Station. INSTAAR days marked our exchanges.

Dr. Bettie Willard and I continued our close environmental activity relationship, and she was particularly helpful to our

agency during her effective tour of duty as a member of the President's Council on Environmental Quality. She helped clarify to her associates several Arctic issues and was an ardent supporter of Arctic research. Dr. Phil Miller was a very capable and innovative researcher for the DOE concerning environmental effects of nuclear power plants and was the first scientist to calculate the role of Arctic tundra in possible global warming—is it a sink or source for CO₂, Dr. Harold Mooney was a very effectual member of Al Johnson's Arctic review panel regarding the DOE Arctic research program and he later chaired a group to evaluate the value of and needed direction of the DOE environmental research program.

Lastly, my two major hobbies, running (racing) and miniature rose growing, link back to INSTAAR. Fourteen years of high-elevation conditioning has enabled me to still race competitively at a national class level—of course within age-adjusted grouping. Additionally, as I had occasionally used army modified bear paw snowshoes while with INSTAAR and fortified by optimistic recall, I made a successful transition from running to snowshoe racing and won three gold medals in the recent (2000) Senior Winter Olympics held in Lake Placid, New York. In many races, especially at a national level I frequently wear an INSTAAR T-shirt.

Though true roses do not appear in the alpine, I certainly was enthralled by plant miniaturization and enjoyed the wild roses found below timberline, which I now include in my miniature rose hybridization program. The most appealing rose developed to date, a sure winner in regional and even in one national show, will be registered as "Michelle's Shadow"—named for past INSTAAR director Pat Webber's daughter. I also have another striking rose that I may register as "INSTAAR's Shadow."

Mark W. Paddock

Joined the Institute of Arctic and Alpine Ecology in September 1952. Worked for the Institute full-time and later part-time until 1954. M.A. in geography at the University of Colorado in 1953. Worked full-time with the USDA in Ames, Iowa, while taking courses in Wildlife management. Worked with the Idaho Fish and Game Department in 1955–1957. Rejoined IAAR in 1957 as chief of operations and facilities, enrolled in biology part-time as a graduate student, worked for IAAR year round and lived at Science Lodge summers of 1958 through 1965. Received M.A. in Biology in 1961. From 1965 to 1971 was assistant director of the Missouri Botanical Garden in St. Louis Missouri. From 1971 until 1991 was associate director of the University of Michigan

I left INSTAAR in 1965 after being there 1952–54 and 1957–65. I went to the Missouri Botanical Garden in 1965 to be associate director till 1971 when I went to The University of Michigan Biological Station to be associate director till retirement in 1991. We—my wife Ruth (whom I met in 1952 at CU) and I—moved from Ann Arbor to a home and 80 acres in Northern Michigan year-round in 1997. This place is almost surrounded by the Biological Station's 10,000 acres and we love it!

Most significant accomplishments post INSTAAR:

- Bringing the Missouri Botanical Garden back from near collapse to a point where it later has become the premier botanical institution in the world. (I worked with David Gates who was Director. Gates was associated with INSTAAR for a few years about 1962–65)
- Co-founded the "Coalition for the Environment St. Louis Region"
- Revitalized the University of Michigan Biological Station (again with David Gates) to a point where it is in the very

top tier of inland field stations in the country. My experience at the MRS was invaluable in this position.

- Co-founded the Tip of the Mitt Watershed Council in northern Michigan. Now 27 years old and with a staff of ten, it is considered preeminent among similar organizations.
- Biological Station at Douglas Lake. Retired in October 1991.

Marith Cady Reheis (néé Marith Jean Reheis)

1974 M.S., University of Colorado (INSTAAR and Geology Department), advisors John Andrews, Peter Birkeland, and Nel Caine. "Source, transportation, and deposition of debris on Arapaho Glacier, Front Range, Colorado."

Ph.D., University of Colorado (Geology Department), advisors Peter Birkeland, John Andrews, and William Bradley. "Chronologic and climatic control on soil development, northern Bighorn Basin, Wyoming and Montana."

Specialties:

Surficial geology and geomorphology Quaternary soils and eolian processes Pluvial lakes in the western Great Basin Neotectonics, especially west-central Nevada and east-central California.

Employment:

Geologist GS-15, U.S. Geological Survey, Earth Surface Processes Team.

Society membership and contributions:

Geological Society of America (1975–present), fellow (1992); Colorado Scientific Society (1975–present), secretary (1977–78), councilor (1993–95); Soil Science Society of America (1980–present); International Association of Soil Scientists (1980–present); American Quaternary Association (1984–present); associate editor, Quaternary geology and soils, GSA Bulletin (1993–present), coun-

cil member, Quaternary Geology and Geomorphology Division, GSA (1999–)

Awards:

University of Colorado (1979–1984): Outstanding Woman Graduate of 1984, Association of Women Geologists Gilbert Fellowship, U.S. Geological Survey (1995–96) Various monetary awards, U.S. Geological Survey, for scientific leadership and for innovative research on relations between geologic surfaces, eolian dust, soils, and desert plant communities.

Field Trip Leader:

Joint FOP–Rocky Mountain cell and AMQUA, 1984, Bighorn Basin, Wyo.–Mont.; INQUA, 1990, Yellowstone area; FOP–Pacific Cell, 1991, Fish Lake Valley, Nev.–Calif.; GSA Section Meeting, 1993, Neogene Tectonism in Southwestern Nevada; FOP–Pacific Cell, 1996, Pluvial Lake Lahontan, Nev.; FOP–Pacific Cell, 1997, Owens Valley, Calif.; GSA Nat. Meeting, 1997, High, Old Pluvial Lakes of Western Nevada; FOP–Pacific Cell, 1999, Quinn River–Alvord Desert, Nev.–Ore.

Member of graduate student committees

Slate, J.L., 1992, Quaternary stratigraphy, geomorphology and geochronology of alluvial fans, Fish Lake Valley, Nevada–California (Ph.D., CU) Noller, J.S., 1993, Late Cenozoic stratigraphy and soil geomorphology of the Peruvian desert, 3°–18°S: A long-term record of hyperaridity and El Niño (Ph.D., CU); Redwine, Joanna (1998–?), Quaternary history of pluvial lakes in Newark and Long Valleys, east-central Nevada (M.S., Humboldt State University); Laabs, Benjamin, (2000–?), Causes and timing of Quaternary lake-level change in the Bear Lake valley, northern Utah and southern Idaho (M.S., Northern Arizona University).

Ross Reynolds

My career started in 1972 when I joined the Institute of Oceanographic Sciences, Birkenhead, Merseyside, U.K. After 15 months there I was appointed to a position in the Department of Meteorology at the University of Reading, U.K. I am a teaching fellow in the department, which means that my principal role is to teach. I have served on the council of the Royal Meteorological Society, have worked on board of its magazine, *Weather*, am a long-standing member of its Education Committee and am now a Life Member after winning its Michael Hunt Award in 1995 (for popularizing the science of Meteorology).

I have published many weather educational materials for tertiary and secondary level education and papers in journals. The most recent relate to Computer-Aided Learning (CAL), generated by my work with the European Community-funded 'EuroMET' project. This offers freely accessible web-based courses on Satellite Meteorology and Numerical Weather Prediction for Universities & Weather Services; it won one of the ten biennially-awarded European Academic Software Awards in 1998. I am currently involved in developing CAL to extend the way in which we teach here.

I taught a graduate summer school course at the University of Oklahoma (apologies) School of Meteorology in 1998. I am in charge of an official link between the two departments, which also involves the flow of students across the Atlantic.

I am the external examiner for the B.Sc. in environmental sciences at University College, Worcester and am soon to be the same for the Royal Navy's postgraduate diploma in meteorology which is taught in their school in the far west of Cornwall.

Finally, I've written a popular (hopefully) text *Guide to the Weather*—the U.S. version is published by Cambridge University Press.

William H. Rickard

Worked with IAEE from 1951 to 1953.

1953–1957 Ph.D. in botany, Washington State College, Pullman, Washington.

1957–1960 assistant professor, biology, New Mexico Highlands University, Las Vegas, New Mexico.

1960–1965 research scientist, General Electric Company, Hanford Laboratories, Richland, Washington.

1965–1991 staff scientist (retired). Battelle Memorial Institute. Pacific Northwest Laboratory, Richland, Washington.

1991–present adjunct faculty, biology, Washington State University Tri-Cities, Richland, Washington.

1991–present faculty research appointment, Associated Western Universities, Richland, Washington.

Sandra E. Ryan

Graduate student affiliation with INSTAAR (1990–1994) and the Department of Geography.

1990–present: research hydrologist/geomorphologist, USDA Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory.

My research on geomorphology and sedimentation processes in steep mountain streams continues since leaving INSTAAR and Boulder. Within this broad field I am working on the influence of streamflow and sediment supply on sediment transport rates, channel processes, and variation in channel morphology. I continue to work primarily in the subalpine environments of Colorado and Wyoming where streamflow is generated primarily by snowmelt. I have also been involved in assessing methods for measuring bedload, including comparing data collected with different types of samplers and the use of underwater photogra-

phy for monitoring bedload movement. In the future, I will be involved with testing the feasibility of an acoustic sampler for detecting gravel movement in coarse-grained channels. New research on the effects of fire on sedimentation and channel processes in a burned watershed near Jackson, Wyoming is planned for the next few field years. Perhaps my most significant accomplishments, however, have been my three little boys: Sam, age 6; Mikey, age 4; and Kellen, age 3.

Dave Sauchyn

I obtained my M.A. in geography from INSTAAR in 1979. I did my thesis research on landslides in the San Juan Mountains under the supervision of Nel Caine. I, of course, have very fond memories of Colorado, Boulder, INSTAAR, and especially the Mountain Research Station, where I lived year-round for two years. I still have good friends in Nederland. After reluctantly leaving Colorado, I obtained my Ph.D. from the University of Waterloo, working under the supervision of another mountain geomorphologist, Jim Gardner. In 1982, I landed an academic appointment at the University of Regina, Saskatchewan, on the Canadian plains (close to my roots). I've been here ever since, climbing through the ranks to Professor. Currently I am seconded to a new climate change research institute, the Prairie Adaptation Research Cooperative.

Kathleen L. Shea

I graduated with a Ph.D. in 1985 from EPOB and did my field work at the Mountain Research Station. I am now an associate professor of biology at St. Olaf College and just finished six years as chair of the department. I did my field work studying spruce and fir and remember many days of taking the shuttle to cabin clearing, just below tree line. I remember taking predawn moisture potential measurements of the trees after camping out all night.

Heidi Steltzer

I was a graduate student at CU Boulder and a member of INSTAAR from 1994 to 1999. My major advisor was Bill Bowman. At this time I am working as a postdoctoral research scientist at Colorado State University in collaboration with Bob Stottlemyer and Dan Binkley. The project I am working on is "Treeline biogeochemistry and watershed dynamics, Noatak National Preserve, Alaska." My most significant post-INSTAAR accomplishment is to have had a successful field season living on a gravel bar in the Agashashok River Valley surrounded by 10,000,000 mosquitoes in the Brooks Range of Alaska.

Ann (Stites) Stringfellow

I was at the institute for five years, served as assistant to Jack Ives and then as a program specialist on the Man and the Biosphere Program.

Rebecca M. Summer

In brief, since INSTAAR I worked for water resource research firms, the Agricultural Research Service, Environmental Protection Agency, and the Gila National Forest. One accomplishment is my work on the Independent Review Team at Sandia National Labs focused on the Waste Isolation Pilot Plant where nuclear waste is being stored.

Harvey Thorleifson

I completed a Ph.D. under the supervision of John Andrews in 1989. The title of my thesis was "Quaternary Stratigraphy of the central Hudson Bay Lowland, Northern Ontario, Canada." I have been with the Geological Survey of Canada in Ottawa since 1986, working on regional projects in northern Ontario and the Canadian prairie region dealing with mineral exploration, offshore surveys, and groundwater.

Colin E. Thorn

Ph.D. 1974.

1973–75: Department of Geography,
University of Montana

1975–79: Department of Geography,
University of Maryland

1979–present: Department of Geography,
University of Illinois at Urbana–
Champaign

1994–2000: head of department, Depart-
ment of Geography, University of Illinois
at Urbana–Champaign

Full member I.G.U. “Periglacial Commis-
sion” (1989–2001)

Publications: one book written, one book
edited, one book co-edited, seven book
chapters authored or co-authored, about
40 refereed journal articles authored or
co-authored.

Funding: Grants from National Geographic
Society and National Science Foundation.

Fieldwork: Research experience in the
mountains of Colorado, Nepal, Norway,
and arctic Sweden

Research interests: Alpine, periglacial, and
theoretical geomorphology.

Leslie A. Viereck

The following is a brief summary of my pro-
fessional and personal career following my
departure from INSTAAR and Boulder in
June of 1959.

When I left the University of Colorado in
June of 1959, I was an “all but”—I had com-
pleted all of the requirements for my Ph.D.
except the thesis. I managed to finish the writ-
ing of this thesis titled “Plant Succession and
Soil Development on Gravel Outwash of the
Muldrow Glacier, Alaska” and defended it in
March of 1962. This study was later published
in *Ecological Monographs* in 1966.

My first position was as an assistant pro-
fessor at the University of Alaska where I
taught botany and ecology courses and con-
ducted research in northwestern Alaska as
part of an Atomic Energy Commission
funded project. This research was designed
to predict the impacts of the AEC’s Project
Chariot, which was a plan to blast a harbor
using five or more nuclear explosives. In
1961 I lost my position with the University
of Alaska as the result of a protest of the mis-
use of data and reports by the AEC. Much
later, in 1993, Dr. W.O. Pruitt and I received
Honorary Doctor of Science degrees from
the University of Alaska and an apology from
the Alaska State Legislature for the Univer-
sity’s actions in 1963. (For a complete ac-
count of this saga see *The Firecracker Boys* by
Dan O’Neill).

Following my firing from the University of
Alaska, I was employed by the Alaska Depart-
ment of Fish and Game as a research biolo-
gist. This was an exciting job because I was
assigned to study Dall Sheep range in the
Alaska Range. As part of this project I was able
to work with my wife, Teri, who was studying
the ecology of the pika, a small alpine rodent.
We were able to spend most of two summers
and one winter in the Alaska Range with our
two young sons and with a dog team that we
used for winter transportation.

In July 1963 I took a research ecologist
position with the newly established U.S.
Forest Service’s Institute of Northern
Forestry on the University of Alaska Fair-
banks campus. I was to keep this position
and the same office until my retirement in
1996. The main emphasis of my research has
been on 1) the effects of wildfire and other
disturbances on boreal forest ecosystems, 2)
permafrost-vegetation interactions in the
boreal forests of Alaska, and 3) forest suc-
cession on the floodplains of the major rivers of
Alaska. In addition to the ecological studies I
continued my interest in taxonomy and veg-
etation classification and co-authored two

books: *The Alaska Trees and Shrubs* (1972) and *The Alaskan Vegetation Classification* (1992). One exciting aspect of my research occurred toward the end of my active Forest Service career when I was the co-principal investigator on the NSF-funded Long Term Ecological Research (LTER) program at the Bonanza Creek Experimental Forest.

In 1996 the U.S. Forest Service closed the Institute of Northern Forestry, and I was forced to retire. However, I still have an office on the UAF campus in the Boreal Ecology Cooperative Research Unit and hold affiliate positions with the Department of Forestry, the Institute of Arctic Biology, and the University of Alaska Herbarium. I have also continued my activities in the Bonanza Creek LTER program, serving on the local Executive Committee. My main research objectives now are to summarize field data from a series of long-term vegetation and permafrost plots that I established in the 1960s and publish several papers summarizing this work. I also have a contract with the National Park Service to repeat the measurement that I made on my thesis plots in Denali National Park in 1956 and 1958 and 1975.

A few “bullets” of important events in my career follow:

1968–69 I spent several months working at the Forest Service Herbarium and National Herbarium in Washington D.C. gathering information for the book *Alaska Trees and Shrubs*.

1970–1971: Under the Government Employees Training Act I spent a year in Norway working with Professor Eilif Dahl. My interest was in the Scandinavian and other European vegetation classification systems.

1973–1976: I spent parts of three summers in the Soviet Union, in both Siberia and the Far East, as an ecologist on a U.S./USSR agreement on “Protection of Northern Ecosystems”. As part of this exchange I also helped to host several groups of scientists and administrators from the Soviet Union that toured Alaska.

1973–1976: Board of Governors of the Arctic Institute of North America

1975–1980: National Academy of Sciences, member, Committee on Permafrost

1975–1990: Editorial Board Arctic and Alpine Research

1977–1985: chairman, Interagency Committee on Vegetation Inventory and Classification for Alaska. Joint State–Federal Alaska Land Use Planning Commission

1978–1995: associate editor *Arctic*

1981–1983: National Academy of Sciences, editorial board for the Fourth International Conference on Permafrost

Co-editor and co-author of the book *Forest Ecosystems in the Alaska Taiga: A Synthesis of Structure and Function*. Springer Verlag, New York

1989–1996: co-principal investigator the Bonanza Creek Long Term Ecology Monitoring Program (LTER)

1993: Honorary Doctor of Science Degree from the University of Alaska

1996–present: U.S. Forest Service emeritus scientist and affiliate professor of forest ecology, University of Alaska

Teri Viereck

I taught biology at the University of Alaska and studied the adaptations to cold of small mammals for the Air Force and the Institute of Arctic Biology. This work allowed me to join Les for some wonderful seasons in the field in Alaska. I continued teaching and doing research for eight years after graduating from Boulder. Then, with the birth of our third child, I felt that field work would be too difficult, and resigned to take up farming with a few animals and a big garden. Soon I began teaching part-time for the Tanana Valley community college in a variety of personal enrichment and holistic subjects. I designed and taught courses in yoga, tai chi, medicinal and edible plants, and holistic health.

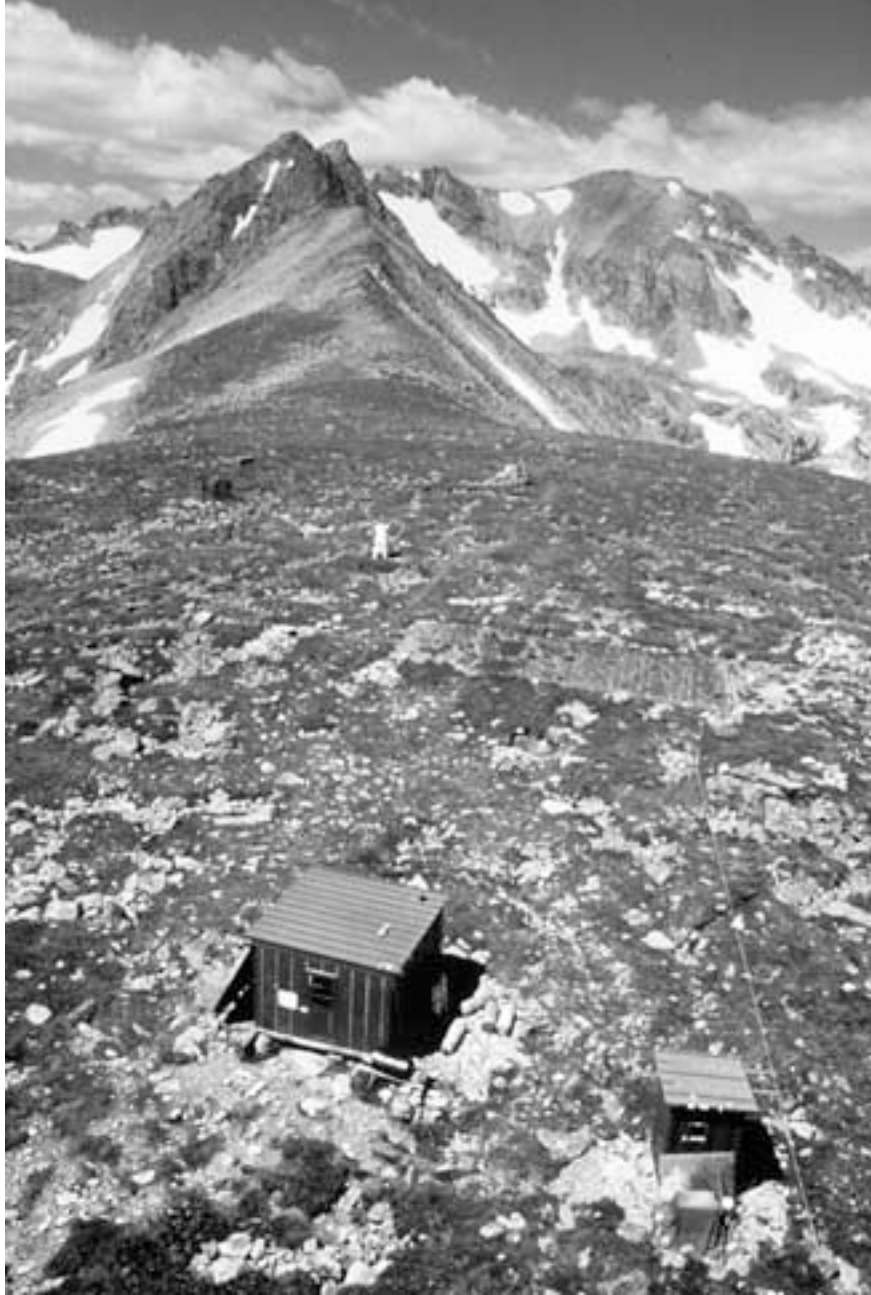
I've published articles on sports psychology and environmental ethics, served as co-chair of the Green Party and helped found a forest rescue organization called Alaska Boreal Forest Council. I have written three books: *Alaska's Wilderness Medicines*, Alaska Northwest Publishing Co. 1987; *Yoga: Skillful Means*. Boreal Pursuits. 1995; *Meditation: A Complete Basic Guide*. New World Library. 1998.

I am still teaching yoga for senior citizens and giving inspirational workshops in body-centered healing practices. I just started learning to paint.

Del Wiens

Surprisingly, I stayed at the University of Utah for the rest of my career. Since leaving CU I published 70–80 articles (not including abstracts) and four books. I was major of professor for ten graduate students, two hold tenure appointments (Penn and BYU, another two are MDs, the others I'm uncertain about).

My most significant accomplishments? 1) the discovery of a new system of sex determination and sex ratio distortions in African species of *Viscum* (Viscaceae) (Publication in both *Science* and *Nature*, plus others in *Heredity* and *Chromosoma*); 2) the First documentation of non-flying mammal pollination (rodents, in the Cape region of South Africa) (publications in *Nature* and *Annals of the Missouri Botanical Garden*); 3) mimicry in mistletoes and other plants (publications in *Evolution* and *Evolutionary Biology*); 4) the discovery that seed set in plants is largely under genetic control (publications in *Nature* and others in *Oecologia*); 5) systematic studies of dwarf mistletoes (*Arceuthobium*, Viscaceae) with the discovery of 23 new taxa of dwarf mistletoes in Mexico and Central America (subject of two books on dwarf mistletoes with F.G. Hawksworth); 6) systematic studies of the mistletoes of Africa (subject of a book with Roger Polhill) with 282 species, with numerous new species described. I am presently initiating studies of the causes of rarity and extinction in southwestern Australia (kwongan) emphasizing the loss of reproductive capacity as the result of genetic load.



D-I climate station at 3,749 m asl on Niwot Ridge, 1988. Photo by LTER.

Fifty Years of INSTAAR Theses

- Abbott, M.B. 1991: Radiocarbon dating and interpretation of sediments in five lake systems along Frobisher Bay, N.W.T., Canada, 237 pp. M.Sc. Directed by: J.T.Andrews.
- Agard, S.S. 1979: Investigation of recent mass movements near Telluride, Colorado, using growth and form of trees, 157 pp. M.Sc. Directed by: W.C. Bradley.
- Alford, D.L. 1973: Cirque glaciers of the Colorado Front Range: mesoscale aspects of a glacier environment, 198 pp. Ph.D. Directed by: J. D. Ives.
- Amundsen, C.C. 1967: The subalpine forest of Wild Basin, Front Range, Colorado, 129 pp. Ph.D. Directed by: J.W. Marr.
- Anderson, L. 1998: Quantitative paleoclimatic reconstructions for the Late Quaternary of southern South America based on calibration of modern pollen and climate relationships, 219 pp. Ph.D. Directed by: V. Markgraf.
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