THE QUaternARY GEOLOGY AND GEOMORPHOLOGY DIVISION

CURRENT RESEARCH ACTIVITIES

George W. White, Univ. of Illinois, continues field study, map compilation, and report writing of areas in the Allegheny Plateau in northeastern Ohio, supported and published by the Geological Survey of Ohio. Field work in the summer of 1973 with Stanley Totten of Hanover College resulted in a report on Mahoning and Columbiana Counties, Ohio. A report by White on Ashland County, Ohio, is now in press. White and Totten continued field work in Ashtabula County, Ohio, in the summer of 1974.

Art Howard, Stanford Univ., still serves on Ph.D. committees involving geomorphology and Quaternary stratigraphy, and teaches winter quarter each year. He is the principal contributor and co-editor (with Irwin Remson, hydrogeology) of a book, well under way, on geology in environmental planning, intended as an elementary undergraduate text. He spent about five weeks in Belem, Brazil, as consultant on air photos and air imagery of the Amazon.

Robert Sharp, Cal Tech, has been working mostly on the “Quaternary geology” (landforms) of Mars. Included are the so-called channels, at least some of which appear to be erosional in origin and very probably fluvial.

William B. Bull, Univ. of Arizona, is evaluating the interaction of base-level processes such as tectonic uplift, erosion, and deposition in an attempt to define equations and make maps of Quaternary tectonic activity of mountain fronts in parts of the Basin and Range province. The impact of Quaternary-Holocene climatic change within the fluvial systems is also being studied.

Larry Lattman, Univ. of Cincinnati, spent the summer of 1974 in Arizona and New Mexico trying to determine if the types of caliche and controlling factors are the same there as in Nevada (GSA Bulletin, September 1973). This work is supported by the U.S. Army Research Office.

A. Dreimanis, Univ. of Western Ontario, London, Canada, is working on two continuing projects: (a) tills and their genetic classification based upon field and laboratory criteria; and (b) correlation of the last glaciation across the northern hemisphere (jointly with A. Raukas from the Geology Institute of the Estonian Academy of Sciences in Tallin). An M.Sc. thesis, “Glacial indicator trains near Gullbridge, Newfoundland,” and three other graduate theses are near completion. Dreimanis participated in the 9th INQUA Congress in Chirstchurch, New Zealand, and presented papers jointly with Raukas and E. A. Francis, as progress reports on the above topics. In 1974-75 he will be on sabbatical leave and will try to complete unfinished mapping projects in southwestern Ontario.

Peter Birkeland, Univ. of Colorado, has recently spent some time in the High Sierras and Wind River Range. He and Jim Yount, Scripps, compared late Quaternary rock weathering and soil development of the Sierras with that of the Rocky Mountains and concluded that Sierran rocks are equivalently or more weathered but soils less developed than materials of the same age in the Rockies. Pete spent a month in the field with Dan Miller, Colgate Univ., finishing up late Quaternary glacial stratigraphy in the southern part of the range, and with Ralph Shroba, he worked on deposits fronting the Dinwoody and Gannett Glaciers in the northern part of the range. One preliminary conclusion is that the Gannett Peak deposits in the northern part are mainly equivalent to the youngest neoglacial deposits recognized in the Colorado Rockies and do not include Audubon deposits. In the summer of 1974, Pete was on southern Baffin Island with Bill Locke to put together a rock weathering and soil development story on tills and beach deposits of different ages.

P. P. David, Univ. of Montreal, is continuing research on loam chronology of Brandon Sand Hills, the stratigraphy of the Great Sand Hills of Saskatchewan, and the glaciochronology of the Gaspe area of Quebec. A paper on the Quaternary stratigraphy and glacial chronology of northern Gaspe is under preparation. Master’s theses recently completed include “Surficial geology of Herschel Island, Yukon Territory,” and a study of fluvial terrace deposits and the late-glacial lacustrine and marine deposits of the Ste. Anne River valley of Gaspe.
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G. H. Miller worked along the spectacular trough that leads from southern to northern Cumberland Peninsula, called Pangnirtung Pass. A feature of the area is the tremendous number of buried organic layers - a number which are currently being dated. In places bedded sands are up to 4 m thick. There is a good neoglacial sequence in Pangnirtung Pass and late glacial moraines are at, or being overrun by, the current glaciers. Other work included a re-examination of the cryostratigraphy on the Cumberland Peninsula and observations on marine limits and weathering in the Isfjorden Bay area. Further work was hampered by the fact that a polar bear had been killed in a road accident near Toolik Lake while the NARS 22 ft. freighter canoe that had been cached for the winter.

Dana Etherwood, INSTAAR, and her husband Bill worked at a number of sites in Cumberland Peninsula on the problem of chemical and physical weathering in an arctic environment. Special interest was the process of permafrost formation. In addition to studies on the sea ice, supported by NASA, using orbital and radar data and remote sensing imagery to map stream network geometry and other geomorphic parameters that can be related to flood potential. Fluvial erosion processes are studied in the San Juan Mountains by D. Sharp.

Vic Baker, Univ. of Texas, reports work on geomorphic effects of Holocene flooding in central Texas in cooperation with the Univ. of Texas Biology. Relative infrequent, high-magnitude precipitation events induce spectacular channel erosion on the high-gradient stream of the Balcones Escarpment in central Texas. Preliminary work indicates that channel morphology in these drainage basins is dominated by extreme ephemeral and extratropical floods rather than to the more frequent median annual flood. A project on relationships between drainage basin morphology and stream flow is supported by NASA using orbital and radar data and digital terrain data in the Arapaho Glacier. Mud flows and current rates of geomorphic processes are being studied in the San Juan Mountains by D. Sharp.

For Joe Hartshorn, Univ. of Massachusetts, this past year has been a year of catching up with the vast amount of literature in geomorphology and Quaternary studies at the libraries of the Sedwick Museum and the Department of Geography, Cambridge University. Joe is preparing a glacial geomorphic study of palaeoglaciologists and English-style geographers to see what is going on in the current world of geomorphology in Europe. He spent two weeks in Iceland working on proglacial lakes with Geoffrey S. Botting, Univ. of East Anglia in Geog., and his work has been published in the study of sedimentation in glacial lakes and on the environment in front of the Malaspina Glacier to various groups around England and in Belgium.

M. Gordon Wohman summarizes work at Johns Hopkins as (1) Mapping of the vegetation of Maryland and some associated studies on stratigraphy and paleoecology of alluvial deposits; and (2) Studies of urban stream channels and the removal of debris (as one of the graduate students remarked, the study of the rounding of market cart). (3) Theses: (a) ecology and geomorphology of por- tions of the Fenscare, Colorado (a State of Colorado project), and (b) glacial geomorphology and environmental considerations in several quadrangles in Connecticut (a USGS project); (4) Study of the historical change of the lower Susquehanna River; and (5) Recently published studies by John Cotta on the effects of Hurricane Agnes flooding.

J. T. Andrews, INSTAAR, spent the 1973 summer season in the Padre/Kingfisher Fiord area of Cumberland Peninsula, Baffin Island, as part of a larger helicopter-supported study on the Quaternary geology and current geomorphological processes operative within the newly formed Baffin Island National Park. A feature of the area was considerable thicknesses of fine-graded sand and soil sequences on both sides of the present river. The deposits were tentatively interpreted as alluvial fans interbedded with peat layers. Weathering and soil studies were used to define the extent of the Wisconsin and Wisconsin glacial ice limit. Marine limits were studied and shells collected for C14 dating. Office work in 1973-74 was spent on an NSF grant on the problem of inception of the Laurentide ice sheet. A large number of people are involved in this study.

Jack Ives, INSTAAR, was elected chairman of UNESCO working group 6 of the new international program "Man and the Biosphere." This summer he visited the western Torneträts Mountains and the north-central interior plateau of Labrador-Ungava with the specific aim of collecting numerous peat monoliths and lake sediment cores to examine the late glacial and postglacial vegetational and climatic history of the peninsula.
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Robert F. Baquim, Iowa State University, just started mapping of surficial geology of portions of the Bighorn Mountains in Wyoming for environmental and land use planning by the Forest Service. Partially supported by NSF, this work is a part of a United States Geological Survey project on the Des Moines River in Iowa relative to bedrock topography and drift thickness. Almost completed with Nick Van Driel is a series of computerized land use and resource inventory studies of Story County, Iowa.

Dick Stone, USC, is coauthor of "Geology, Seismicity and Environmental Impact," a book published by the Southern California Earthquake Engineering Society among the 49 articles are a dozen or more related either to the Quaternary or to geomorphic features and processes. These include Submarine Mass Failure and Sediment Substrate Associated with Oil Production Operations at Long Beach; Space-Time Relationships of Landsliding in Palos Verdes; Permafrost and Bank Stability along the Mackenzie River; and Tributary Territories, Canada: Patterns of Ground Rupture in Fault Zones; and Beach Changes in a Low-Energy Coastal Area in Florida. Graduate students at USC are studying evaporite deposits of the Laguna Playa and the southern portion of the Sierra Madre in northern Sonora, Mexico, and the Quaternary history of the area; and studying wind directions, sand movement, dune types, and sand encroachment in the southeastern portions of Palm Springs, California.

Donald R. Coares, SUNY at Binghamton, organized the Fifth Annual SUNY Geological Symposium on September 27 and 28, 1973, on the theme "Glacial Geomorphology" with 15 outstanding glaciologists, including Bob Legget from Canada and Cuchulain King and Geoffrey Beresford from England. On day 2, "Reappraisal of the Glaciated Appalachian Plateau" show this region to be much more diverse than generally believed, and divide it into ten different sections. The third volume on "Environmental Geomorphology and Landscape Conservation" was scheduled for publication by late summer 1974 and concentrates on urban areas. A correlation of topographic anomalies and glacial deposits that can be made with data derived from the above models based on a single or basalt sheet system has recently been completed. Computer-generated curves, when superimposed on a three-dimensional topographic model, suggest a new approach to the understanding of glaciation in a rugged terrain. The third year of a Sea Grant project "Glaciated Erosion, Stabilization, and Utilization of the South Shore Long Island, N.Y." is now starting with Don as director and Marie Mortawai as co-investigator. Six environmental booklets for use by high schools that teach environmental science have just been published by SUNY. These materials were developed during NSF institute and workshop. Both teacher materials and student projects and experiments. They are now ready for distribution and cover a broad spectrum of environmental affairs. Don is helping to write the Broome County Environmental Master Plan, and writing road aggregate source reports for New York State Department of Transportation.

Ernest L. Kern, Southeast Missouri State Univ., is presently completing a detailed study of the geology of Klump's Cave, a cavern system approximately one mile in total length located in Perry County, Missouri. The focus of the study is the determination of the speleogenesis of the cave, including studies of its stratigraphic position, its origin, development, and orientation relative to the geological strata of the surface topography, cave fills, and cave and sub-surface hydrology.

Stafford C. Happ, Oxford, Mississippi, is continuing studies of sedimentation and related erosion, in valleys of Mississippi, Minnesota, and Wisconsin, based on surveys initiated for USDA in 1936-40.

William A. Gallant, Denver, is presently under contract to the Bureau of Indian Affairs to study the historic meander development of the Mississippi River in Iowa and Nebraska, involving a sedimentation and morphology approach to the problem.

David M. Mark, Univ. of British Columbia, has completed a master's thesis which compared two computer terrain storage systems (regular grids, irregular triangles) with respect to the evaluation of certain geomorphic parameters. He plans to continue with research into the use of computer analysis and surface behavior. He has also reviewed procedures for analyzing till fabrics and related fabrics, and attempted to relate the statistical results to fabric-forming processes. His strength in these studies is that different methods produce statistically different fabrics, and is working with John Andrews to re-analyze his Buffalo Island cross valley moraine fabrics and to relate these to earlier results and processes.

Archie Stalker, Geological Survey of Canada, spent about six weeks doing field work in Alberta and Saskatchewan, mostly in further collecting at fossil vertebrate sites. During part of that time he was accompanied by C. Conroy in a search for the fossil forest and rock exposure at the Univ. of Toronto. One new bone site, north of Irvine, Alberta, was investigated which is apparently of the same age as the Wetselck Valley site, or straddling the Pleistocene-Pleistocene boundary. Work was concentrated on the Wahlenbergian of the Swift Current, Saskatchewan and the Galt Island Site (near Medicine Hat, Alberta) of Middle Wisconsin age. At the former site, material was screened for robes but bones and teeth, ash samples were gathered for paleomagnetic study and more volcanic ash was collected. At Galt Island, small bones and teeth were collected from a new horizon estimated to be about 35,000 years old. Another bone bed there was 39,000 years old. A still younger one is also present, but unexplored as yet. More information is also being gathered on the gigantic bedrock blocks found between till sheets (some weighing many millions of tons).

W. R. Cowan, Ontario Dept. Natural Resources, is presently mapping Lake Huron and Georgian Bay lobe deposits of late Wisconsin age from 43° 45' to 44° 00' north and from longitude 80° 00' west to Lake Huron (approximate longitude 81° 45'). Several till sheets of Port Bruce Stadal and Port Huron Stadal affinities are present as well as one till sheet related to the older Missouri Stadal. Other activities include the investigation of a Middle Wisconsin interstadial site near Woodstock, Ontario, trend surface analysis of four major till sheets in the Brantford- Woodstock area of southern Ontario, and discriminant analysis of textural and lithologic properties of the same till sheets.

Current Quaternary research of David Branagan, Univ. of Sydney, is concerned with the origin of widespread patterned rock surfaces in the Sydney region and Quaternary earth movements in the Sydney Basin, New South Wales.

James R. Underwood, Jr., is concentrating on the study (mapping) of the Acidalium Planitia region, Mars. Interest in the quadrangle is heightened by the fact that the Viking "B" prime landing site, Cydonia, is in this quadrangle.

Present activities of Kerby E. LaPrade are still centered on Tertiary-Pleistocene Recent glacial history and the origin of landforms, Transantarctic mountains, East Antarctica and Ellsworth Land, West Antarctica.

Thornton L. Neathery, Geol. Survey of Alabama, has undertaken research studies to ascertain criteria for the recognition of recent faulting and other structural problems related to engineering geology in the Coastal Plain areas of Alabama. This work is still in the planning stage although several small pilot projects were undertaken and completed last year. During the coming year preliminary investigation into recent structural manifestations in Alabama is scheduled for completion.

Denis E. Marchand, Bucknell Univ., began a study last summer of the chemical weathering of oligotroph ice in five sites of the Canadian Shield under varying present-day climates. The five anorhorriths are located in southern Virginia, the Adirondacks of New York state, southeastern Wyoming, northern Idaho, and southern California. The research will include chemical analysis of bedrock, soils, and groundwater, x-ray diffraction studies of clay mineralogy, and possibly some laboratory investigation of plagioclase weathering. Research is also being conducted on the Pleistocene stratigraphy and chronology of the central Susquehanna Valley and on the impact of biological processes and land use on water quality, especially sediment yields and cation concentrations.

John A. Elson spent six months (sabbatical) in the American West getting acquainted with desert phenomena with the objective of getting a feeling for the geology of the western United States. Most striking was the different order of magnitude of time involved in the geomorphic processes. In Canada, processes are thought of in postglacial terms, and the time interval is apt to be 10,000 years whereas in the Southwest the time is orders of magnitude greater. Research interests were maintained in two areas: that of tufas as a cold climate indicator was suggested long ago by Blackwood and is there a "tufa" talus line similar to former snowlines represented by Pleistocene cirque? The importance of lithology quickly emerged as a major element, since laves produce talus tufs to sea level in Mexico. However, sandstones and intrusive igneous rocks probably do show a former climatic talus line. What could emerge from this kind of study is improved information on the resistance of rocks to weathering in different environments. The second research interest was the development of a system of ground level multibeam photography using wave lengths ranging from ultraviolet to infrared, to discover if the method could be more useful in airphoto geology
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than is apparent from the literature. Multiband photos of about 50 types of geological exposures were obtained, ranging were scenes in which age relationships might be determined from desert varnish to close views of igneous rocks in the hope of finding from thereon obvious, nothing magic has appeared, but use of the system may be worthwhile for some specific materials, possibly where carbonates are in a sequence of clastics. Two M.Sc. students are working on the Quaternary geology of southern Quebec and the project on the geomorphology of placers in the north-west territories is moving ahead.

Detlef A. Nørnke, Calif. State College, Haywood, is continuing petrographic studies of rocks inhabited by lithopityic (especially endolithic) algae and evaluation of possible geomorphic effects caused by these structures (with E.L.C. University). He is also working on evaluation of petrographic determinants of pediment evolution in parts of the Mojave Desert and investigation of climatic changes through sediment-petrographic methods, emphasizing studies of quartz-grain surface features by differential-interference microscopy.

J. C. Dionne, Laurentian Forest Research Center, Quebec, is involved in a three-year program of mapping Quaternary deposits in a large area located between latitudes 52°-55° and longitudes 76°, 79°. The work is mainly done by photo-interpretation with field checking of units mapped using a helicopter. This mapping program is part of an ecological study of the Department of Canada Environment for the "Societe de Development de la Baie de James" in connection with hydroelectric projects in that area. The region studied includes a large area formerly covered by the Tyrrell Sea and the area where the remnants of the Laurentide ice sheet met the ocean. Data collected to date is assisting in understanding of late-glacial events. Drift ice features along shores, rivers, and lakes are also being studied in that area.

Reginald P. Briggs, USGS, Carnegie, Pennsylvania, is presently working with William E. Davies and others of the USGS on a multi-disciplinary project sponsored by the Appalachian Regional Commission, chiefly (but not entirely) aimed at Allegheny County, Pennsylvania. The job includes an earth-disturbance inventory (lakeshore and lakeside susceptibility, strip mines, mine subsidence development, etc.), groundwater studies, land use mapping, preparation of slope maps, and other facets, and the integration of these into a whole. Parallel work under ARC sponsorship is being done by the Allegheny County Department of Planning and Development and by the Center for the Study of Environmental Policy of the Pennsylvania State University. The goal of this three-party effort (styled UPLRA for Land Use and Physical Resource Analysis) is a firm insertion of factors of the physical environment into the land use planning and decision-making processes. In short, it is a program that starts with basic research on factors affecting, chiefly, the area and carries on through applied research to application.

Marie Morisawa, SUNY at Binghamton, is working on a variety of problems including (1) hydrologic and geomorphic effects of changing land use, urbanization, and channel modifications in the Binghamton area; (2) land use and open space inventories in Binghamton, New York, scenic and recreational features in New York; (3) coastal erosion and stabilization studies on the south shore of Long Island. Editing and publishing of "Physical Geographers Proceedings of the 1972 Geological Society of America Geomorphology Symposium at Binghamton" is complete. Copies are available from M. Morisawa. Publications in Geomorphology, SUNY, Binghamton, New York 13901.

Jane L. Forsyth, Bowling Green State Univ., reports that study continues on the late Wisconsin history of the western end of the Lake Erie area, with a publication out in the fall issue of the Compass of Sigma Gamma Epsilon entitled "Late-glacial and postglacial history of western Lake Erie." An exciting contribution to this subject came through an informal field conference in western and central New York state where drainage channels from the Buffalo area to east of Syracuse were observed. Of particular interest was a gravel pit in which the rocks contained from about three feet in diameter—nothing but a tremendous flood, of the kind that must have emptied Lake Erie when the ice first retreated far enough north for eastern drainage to occur, could explain such a large and soft (material). Less systematic but exacting was a chance to see glaciated landscapes in Scandinavia earlier this summer. Similar observation of Swiss mountain landscape will be the theme this summer in a class by botanists from the Univ. of California. This latter trip also relates, in a general way, to the continuing research being done in Ohio on the relationship of plant distribution to physiographic substrate: e.g., goldenrod (Solidago) on pine barrens, white pine (Pinus strobus) on pine barrens, black pine (Pinus nigra) on pine barrens, and more recently, balsam fir (Abies balsamea) on pine barrens, and pine barrens. When all is said and done, the work is still ongoing.

C. C. Reeves Jr., Texas Tech. Univ., has been mainly involved in coring large glacial lake basins in West Texas, using basin morphology/drainage to deduce paleoclimatic parameters. Anyone interested in doing some Pleistocene pollen (probably post-Kansan to Early Wisconsin) on the local floras contact Dr. Reeves for second papers on this subject (expected in 1972). A book on Caliches of North America has been submitted for publication. He traveled throughout the western United States this summer on caliche studies.
Daniel J. Stanley, with associates and graduate students at the Smithsonian Institution’s Division of Sedimentology in Washington, D.C., are focusing on problems of sedimentary processes in deep marine environments, including basins in the Mediterranean Sea and the continental margin off the Mid-Atlantic States in the northwest Atlantic. Particular attention is being paid to the origin and dispersal of the unconsolidated Quaternary outer continental shelf sediments including those in straits and on the shelfbreak, canyons, fans, and basin plains in both the eastern and western Mediterranean. Emphasis is present in examining the differences of deep sea muds (hemipelagic deposits, mud turbidites, etc.), using X-radiographic and mineralogic technology. Preliminary studies show a striking analogy between the eastern and western Quaternary sections in modern ocean settings and those of turbidite-rich sequences, including fish facies, preserved in the fossil record.

Dennis N. Nielsen, Winona State College, recently received a research grant for studying Quaternary stratigraphy in southeastern Minnesota. He and students are presently doing field work in the drift regions east of the Mendota drift border where they hope to define specific lithostratigraphic units for the region and attempt to correlate units with others in Minnesota and adjacent areas.

Research activities of Richard H. Ragland, Arctic Inst. of North America, include continuing the inventory of glaciers and related features in the St. Elias Mountains of Canada, and, as time permits, continuing study of the drainage history of Kluane Lake, Y.T., and interpreting data from temperature, mass balance, and surface movement measurements of the Kaskawulsh Glacier, Y.T.

M. Artesian Saines, Harza Engineering Co., Chicago, was involved in a prefeasibility level study of the terraced valley-fill deposits in the Upper Magdalena Valley of Colombia, South America.

R. J. Pike’s morphometric studies of terrestrial and extraterrestrial craters lately expanded into the realm of multivariate statistics. The impact hypothesis story still appears to best explain most craters on the Moon. However, his lunar photosandlamic map of the Hyginus Rille area contains a crater that closely resembles Trou-au-Natron volcano in the Tihedj Massif. Other research is directed toward various quantitative descriptors of terrestrial land-form and toward relative-roughness analysis of Mars in preparation for the 1976 Viking lander.

Alan Jopling, Univ. of Toronto, spent a half-year sabbatical leave in Europe in 1973. For part of this time he worked in the Geography Dept., University of Reading, and for the other part in the Geomorphology Laboratory, University of Uppsala. His research at Reading focused on the historical aspects of glaciocluvial sedimentation. He also carried out a flume study of silt transport in the Geomorphology Laboratory at Uppsala.

Joe Creager and others, Univ. of Washington, have been studying modern sediments and benthic foraminifera of the southeastern Bering Sea continental shelf. Extensive acoustic-profiling records have permitted production of a revised bathymetric chart of the southeastern Bering Sea continental shelf. Factor analysis of sedi- ment texture has identified five factors whose distributions and associated sediment characteristics are in accordance with available physical oceanographic data and published transport models. Sediment characteristics in water shallower than 50 to 60 m suggest the influence of active resegregation whereas deeper sediments appear controlled by settling velocity and distance of transport.

Joe Creager and Mark Holmer, Univ. of Washington, combined fieldwork on Holocene history of the Lapvet Sea continental shelf. The 400-km-wide, low gradient Lapvet Sea continental shelf consists of flat terracelike features at regular depth intervals from 10 to 40 m below present sea level. The five large submarine valleys traversing the shelf do not continuously grade seaward but contain elongate, closed basins. These terraces and closed basins plus deltaic sediments associated with the submarine valleys quite possibly mark sea level stillstands, and enable reconstruction of the paleoecology of the Lapvet Sea shoreline at five periods during post-Wisconsin (Holocene) time.

William Dietrich, Univ. of Washington, studies sediment production and transport from a deeply dissected basaltic highland in central coastal Oregon. Field work has consisted of mapping bedrock, landslide, and volume of stored sediment in the Rock Creek watershed south of Yachts, Oregon. Petrographic descriptions of the soils, sand-size stream sediment, and beach sands are in progress.

Derrill Herrd, Univ. of Washington, is investigating the glacial and volcanic geology of the Ruiz-Tolima volcanic complex in the central Cordillera Central of Colombia. Outcrop of the complex is related glacial and volcanic records hereafter reported in South America was used to develop a history of volcanic and glacial events in this complex. This chronology, which has been partially dated by radiocarbon dating and fission-track dating, provides the first radiometric evidence of a late Pleistocene pro-Wisconsin glacial advance in the Andes, and suggests that major late Quaternary climatic fluctuations in the northern Andes were broadly contemporaneous with those of higher latitudes.

William Scott, Univ. of Washington, is working on distribution of heavy metals in Puget Lowland lakes and bogs. Emphasis is on the local changes in heavy metal content of lake and bog sediments during the last few centuries in an attempt to evaluate the effects of human activity (especially smelting of ores) on heavy metal distribution. He is also studying Quaternary geology of the Metolius River area, Oregon. Using weathering and soil characteristics of the drifts and stratigraphic relationships to infer old volcanic rocks, a sequence of three major Pleistocene glaciations, a late Pleistocene-early Holocene advance, and a twofold late Neoglacial advance has been developed.

Hugh Mills, Univ. of Washington, is investigating the genetics of alpine glacier development. Sedimentary parameters examined include size distribution, fabric, roundness, and shape.

Minze Stuiver and Stephen Robinson, Univ. of Washington: As part of the GEOSECS program of the International Decade of Ocean Exploration, high-precision determinations of radiocarbon content are being performed on marine bicarbonate samples from vertical profiles along transects through the Atlantic and Pacific Oceans. These data are being applied to problems of oceanic circulation, mixing, and transfer across the ocean-atmosphere interface. Development work is in progress to make possible the use of high-precision radiocarbon dating to approximately 70,000 B.P. The method employs isotopic enrichment by the thermal diffusion process.

Minze Stuiver and Albert I. C. Yang, Univ. of Washington: Potassium-argon dating is being performed on Pleistocene basaltic lavas from Mauna Kea, Hawaii. The results are in agreement with stratigraphy worked out by S. C. Porter, who collected the samples, and range from 0.6 to 0.4 m.y. Potassium content of these samples is less than 1.5% and the extracted argon contains an atmospheric contamination of 96 to 98% that is not removable by baking at temperatures as high as 700° C. Consequently, for the younger samples the error in the measured age can be as high as 50%.

Don Tubbs, Univ. of Washington: Landslides included in the Federal disaster records of early 1972 are being field checked to determine the mechanics of failure, stratigraphic controls, and human influence. News accounts of the last half century are being compared to climatic records to isolate weather influences and assess the recurrence interval of periods of severe landsliding. Several methods for identifying hazardous areas are being evaluated.

Matsuaki Tsukada, Univ. of Washington: The QRC Palynology and Paleoecology Laboratory is focusing on selected aspects of Quater-
nary paleoecology of Asia. A vegetation map during the last full-glacial period (25,000÷15,000 yr B.P.) in Japan has been compiled from various pollen analytical results. Tsukada and his associates have also collected a 7-m core from the Moat of the Imperial Palace of Japan. The analyses of the pollen and spores of the metal and this core will help to elucidate the environmental history of Tokyo, one of the most populous cities in the world.

Lincoln Washburn, Univ. of Washington: A laboratory study of processes responsible for frost sorting and patterned ground has been started and will be eventually extended to include frost creep and gelifraction. The work is being carried out in cold rooms capable of temperatures of as low as -50° C. A unique tilting slab about 3 x 5 m in area and able to contain a 1-m thickness of soil over a simulated permeable base is being utilized. Advisers who have worked at the laboratory include Dr. A. B. Band and Dr. Akira Higashi. The staff includes Dr. Chester Burrous, Jun Hiyakawa, Tom Persson, and Philip Taylor.

Van Stynk Williams, Univ. of Washington: Pattern of ongoing tectonic deformation along a portion of the Himalayan Mountain range in eastern Nepal. Evidence from segmented alluvial fans at Dhuran and stream terraces in the Sapti Kosi River basin form the main study.

Under the supervision of R. H. Hadley, USGS, hydraulic and geomorphic studies are continuing in the prototype oil shale lease areas in the Piceance Creek basin of western Colorado. These investigations include erosion rates and transport for stream channels and on hillslopes to acquire baseline data prior to mining. Observations on these sites are planned during the mining operations. A report is being prepared on the results of two years of the study in cooper-
Don J. Easterbrook, Western Washington State College, has just completed a report on Environmental Geology of Whatcom County which includes sedimentology, slope processes, eluviation rates, relative response to earthquakes, ground water, engineering properties, and interaction of man's activities and natural processes on the North Fork Puyallup. A draft of this work was published as USGS Folio 854. Work continues on the paleomagnetism of Pleistocene sediments in the Puget Lowland and elsewhere and on neoglacial of the North Cascades near Mt. Baker. Research on stratigraphy and geochemistry of a new outcrop has just been published which ties in with a study of the Olympia nonglacial interval. Continuing are efforts with IGU Correlation Commission to correlate glacialites in Europe and North America.

R. A. Bagnold and Luna B. Leopold continued work this spring on the machine to trap all bedload material in a medium-sized river, measure it on the stream bank, and return it to the river. Leopold, now retired from the USGS and a professor at Berkeley, continued work in summer in Wyoming on measurement and processes. W. W. Emmett of the USGS, Boise, Idaho, continued his measurements of channel and hydraulic characteristics during flood on Idaho rivers. A manuscript on this subject has been submitted to the Survey for a Professional Paper. Emmett, Leopold, W. B. Bull, Linie Washburn, and Larry Lattin were among the geomorphologists attending a symposium in Israel on desert processes.

John Moss, Franklin and Marshall College, has just finished a paper, "Relation of River Terrace Elevation with the Shoshone River, which flows from the Absaroka Mountains into the Bighorn Basin. This, of course, is the locale of Hoover Mackin's classic papers on glacial geology in Wyoming. The Cody terraces. The origin of the terraces proves to be somewhat more complicated than Hoover realized. The terraces are traceable with remarkable continuity from moraines in the mountains, through a glacial lake, and far to the basin area. The study is being made which to study downstream change in morphology, sedimentology, and gradient. Also near completion is a paper on the geologic effects of the Hurricane Agnes flood. The main focus is on the Conodoga River, a tributary to the Susquehanna in southeastern Pennsylvania. This has involved some interesting problems of why rainfall of only 8 to 9 inches in 51 hours produced the highest flood ever recorded. In much of the Susquehanna Basin, where rain exceeded 18 inches, the magnitude of the flood and the severe erosion are more easily understood. By contrast, in the Conodoga, despite an enormous increase in discharge up to 18,000 cfs, little widening or deepening of the channel took place nor was there recognizable deposition of sediment on any miles of the long-mutated floodplains.

Current research endeavors of Richard Williams, USGS, Reston, Virginia, in association with a number of Icelandic geologists, are directed at a study of different dynamic geological phenomena in Iceland. Types of geological phenomena under study include variations in time of thermal emission from geothermal and volcanic areas, changes in stream channels and confluence lines, changes in seiche features, variations in ephemeral snow cover, changes in glaciers and related features (for example, moraines, glacier-marginal lakes, snow-lined cliffs). Also, research is being made on the environmental relationships of geologic structure, tectonic features, and volcanic landforms. This research has been under way since 1966 and is based on field observation and analysis of aerial photographs (black and white, color, and color infrared), aerial thermography (thermal infrared imagery), satellite imagery (ERTS-1 and NOAA-2), satellite thermography (NOAA-2), and previously published maps. For the past two years much of the research emphasis has been directed at analysis of ERTS imagery.

Zane Spiegel, Santa Fe, is evaluating the cumulative effects of past and future groundwater development by wells and drainage in eastern Long Island, particularly with regard to the occurrence of ponds and streams and the prevalence of salt-water intrusion in coastal areas. Drillers logs of thousands of wells are being studied in an effort to determine the extent and hydraulic effects of clay and fine sand beds in a matrix of coarse pebbly washout of Wisconsin age which is the principal aquifer of the area. The clay beds are locally important controls for leaky perched and semiperched aquifer elements and for lateral salt water intrusion.

Paul K. Grogger, Univ. of Utah, has finished his doctoral study on "Glaciation of the High Uintas Primitive Area, Utah, with emphasis on the northern Black Fork region of Utah and America at an International Conference on Permafrost, Yobutsuk, USSR, with Rowan Ettinger, Calgary, Alberta.

Randall Updike, Univ. of Wisconsin, is presently conducting a research project which was initiated with Troy Pew in 1966 related to late Cenozoic, and particularly, Quaternary, geology of the San Francisco Peaks, northern Arizona. The study has depicted damed field mapping and laboratory study of the volcanics, glacial geology, and mass movement phenomena associated with the peaks.