

determined and forecasting systems have been applied particularly in the Mackenzie River Basin. Studies of river channels for probable locations for ice jams have been done.

Snow line and snow cover received by far the most attention by other authors and mention was made of techniques being developed to provide quantitative data on snow water content. Snow cover maps are turned out on an operational basis in British Columbia and New Brunswick and on a near operational basis in other areas of Canada as in Ontario and Quebec. Data retransmission was mentioned as well as some of the potential new instruments and techniques which may overcome the two most persistent problems of remote sensing i.e., cloud cover and detection of snow line under coniferous forest cover. These depend on new developments in the visible and near infra red region combined with digital mapping techniques that have been used both with LANDSAT data and with meteorological satellites. Research is underway into aspects of microwave measurements that have promise to measure snow and snow water equivalent even through cloud cover.

It was pointed out that remote sensing is done from both aircraft and satellite platforms and that its ability to provide information is largely related to the ability to differentiate ground detail. The required detail can be seen in remote sensing from aircraft but similar detail is not yet available from satellites. However, images from satellite are rapidly improving and do provide coverage of large areas not available from other sources.

The final session on Special Topics included a number of different subjects not covered elsewhere. The first of these was a very interesting paper on climatic changes by G. A. MacKay (Atmospheric Environment Service), which related the different scales of climatic change from those of short duration to those extending over hundreds or even hundreds of thousands of years to present day interests and their effect on human activities or of human activities on them.

Three papers dealt with chemical aspects related to winter conditions and

the problems of sampling water in the winter. One, considered the effect of the release of sewage lagoon effluents under ice cover on stream water quality and on the biota in the stream. Another described the use of winter water quality to determine sources of ground water discharge. The third, used winter water quality data to separate the runoff components in glacier alpine water sheds.

An interesting paper compared the run-off relationships in the water budgets of three experimental lake basins in the continental climatic region of the Precambrian Shield, in the sub-arctic climatic region of Northern Manitoba and in the arctic climatic region near Chesterfield Inlet. These studies have only been under way for a short time but preliminary indications are that the effects on the fish life in lakes are not as different as might be imagined under these widely differing conditions.

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Symposium on Quaternary Climatic Change

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The fourth Quaternary conference was held at York University from May 18 to 20. Speakers from across North America and Great Britain discussed *methods* of reconstructing paleoclimate. Speakers focused on stratigraphic, pedologic, geomorphologic, isotopic, paleontologic, palynologic and archaeological evidence, as well as the degree of resolution possible, in reconstructing the magnitude of climatic change.

The morning session of May 18, chaired by B. D. Fahey (Guelph University) and J. C. Ritchie (University of Toronto), started with a discussion by A. Ronai (Hungarian Geological Institute) and H. B. S. Cooke (Dalhousie University, Halifax) of the Pleistocene time column and climatic record shown from deep boreholes in the Great Hungarian Plain. Cooke discussed the fauna, pollen, and paleomagnetic record shown by the cores and gave an inferred paleoclimatic interpretation. J. T. Andrews *et al.* (University of Colorado, Institute of Arctic and Alpine Research, Boulder), discussed the terrestrial and ocean paleoenvironment record derived from morphostratigraphy, lithostratigraphy, faunal assemblages and amino acid epimerization in shells from raised marine sediments, which suggest warm inshore water conditions during the last glaciation. The Holocene climatic record from Western North America, discussed by T. N. V. Karlstrom

(U.S.G.S., Flagstaff, Arizona), involved time-frequency analysis at 100 to 200 year intervals of deposits dated by radiocarbon. These deposits cluster in patterns that suggest synchronous climatic histories from Alaska to the southwestern states. A discussion of late-Quaternary climatic changes in the Aleutian Islands, by R. F. Black (University of Connecticut), included details on ice cap destruction, advance and recession of alpine glaciers, changes in elevation of regional snowline, pollen stratigraphy, and tephra distribution. A radiocarbon dated chronology of postglacial geologic events indicated a Hypsithermal Interval between 5,500 and 3,500 BP followed by Neoglaciation from 3,500 to 2,000 BP. J. D. Jacobs (University of Windsor) discussed the relationship between topoclimatic diversity and vegetation distribution in arctic Canada, and their important applications to paleoclimatic reconstruction.

P. Richard (Université de Montréal) and A. Stalker (G.S.C., Ottawa) presided over the afternoon session on the 18th. A. Dreimanis (University of Western Ontario) began with a consideration of climatic conditions as deduced from the nature of glacial deposits. He discussed the paleoclimatic and paleoenvironmental implications of some genetic varieties of till (e.g., meltout, sublimation and waterlain tills) and pointed out that some basal tills contain, as incorporated material, valuable records of those nonglacial intervals that preceded the deposition of the tills. Late-Wisconsin and early-Holocene climatic changes in Jasper National Park, Alberta were examined by M. S. Kearney and B. H. Luckman (University of Western Ontario), who gave evidence for two glacial advances in Recent time: the Crowfoot (6,600 BP) and the Cavell (450 BP-present). The record in the Canadian Rocky Mountains indicates substantially different timing of climatic events there than the three-fold record of Neoglaciation seen in other areas of the Rocky Mountains. Holocene fluvial events and climatic changes in the Driftless Area of Wisconsin were discussed by J. C. Knox *et al.* (University of Wisconsin, Madison). They stressed changes in the

deciduous forest/prairie ecotone, and in a complete sequence of alluvial sediments, as important indicators of Holocene climatic fluctuations. The use of pollen and macrofossils in reconstructing late-glacial and post-glacial palaeoenvironments around the border of the Champlain Sea was examined by R. J. Mott *et al.* (G.S.C., Ottawa). This was followed by a paper on entomological ways of reconstructing palaeoclimate by A. V. and A. Morgan (University of Waterloo). They reviewed insects as sensitive indicators of climate, described the history of palaeoentomological research, and discussed the abundance of organic detritus in different stratigraphic horizons containing rich assemblages of insects. C. R. Harrington (National Museums of Canada, Ottawa) described the origin and late Pleistocene dispersal of saiga antelope. He stressed N. American and N. European extinctions at the close of the last glacial period and the environmental implications of their adaptation to the dry steppe-grasslands of central Eurasia. W. C. Mahaney (York University) focused on the use of buried and relict paleosols in the Rocky Mountains and East Africa as paleoclimatic indicators. Changes in climate induce new and sometimes different soil systems, which survive burial to reveal paleoclimatic information; relict soils found at the surface often retain clay mineral species that indicate a former wetter climate. He showed that present precipitation is inadequate to produce the clay minerals found at depth in soils of post-Bull Lake age that formed during the Sangamon Interglaciation. This first group of papers was followed by the symposium dinner, and a meeting which led to the organization of CANQUA or The Canadian Quaternary Association (Association Canadienne pour l'étude du Quaternaire). D. R. Grant (G.S.C., Ottawa) undertook the post of interim Executive Secretary-Treasurer, until a full executive can be elected.

The third session, led by H. B. S. Cooke (Dalhousie University) and T. N. V. Karlstrom (U.S.G.S., Flagstaff, Arizona) opened with papers on the use of stable isotopes to reconstruct climatic change. D. Fisher and F.

Koerner (presented by S. Patterson, Polar Continental Shelf Project, Ottawa) analyzed data from ice cores taken from the Devon Island ice cap. Power spectral analysis is used to cluster oxygen isotope ratios to provide a detailed temperature record since the end of the last glacial. C. Hillaire-Marcel (Université du Québec à Montréal) discussed the isotopic content of calcareous concretions collected from Lake Deschailions varves. Changes in $^{18}\text{O}/^{16}\text{O}$ ratios suggest progressive depletion of heavy isotopes in the lake water, caused by low precipitation and decreasing temperature resulting from climatic deterioration at the beginning of the Wisconsin Glaciation. R. S. Harmon (Scottish Universities Research and Reactor Centre, E. Kilbride, Scotland) presented quantitative paleoclimatic information derived from stable isotopic composition of speleothems in limestone caves. He stressed the use of stable and chronologic isotope date, which indicated occurrence of glacial climates in N. America at 275,000 to 230,000 yrs; 190,000 to 135,000 yrs; and 80,000 to 15,000 yrs BP.

J. H. McAndrews (Royal Ontario Museum, Toronto) analyzed the fossil pollen record in Ontario, and stressed the importance of linking modern pollen rain with zonal vegetation and climate as a standard against which to establish changes in mean annual temperature from the Sangamon to present. He discussed the lack of evidence for a Hypsithermal Interval in Southern Ontario, but indicated there was a Hypsithermal in Northern Ontario, with temperatures higher than today, which peaked 5,000 to 7,000 yrs. ago. This episode may explain the invasion of prairie vegetation into northwestern Ontario during the mid-Holocene. The paleoclimatic significance of late-Pleistocene and Holocene pollen records in Southern Quebec was discussed by P. J. H. Richard (Université de Montréal). He reviewed the different approaches of various workers to paleoclimatic interpretation of the pollen data for Southern Quebec.

The fourth session, led by J. T. Andrews (University of Colorado, Boulder) and C. P. Gravenor (University of Windsor), began with an account by

R. G. Baker (University of Iowa) of evidence for interglacial and interstadial conditions deduced from pollen and plant macrofossil remains from three sections in Yellowstone Park older than about 70,000 years BP. J. C. Ritchie (University of Toronto) discussed the role of pollen analysis in Quaternary environmental reconstructions, and stressed the importance of finding complete pollen records of high resolution that contain the glacial/interglacial and stadial/interstadial signals. An important discussion of the inconsistencies between beetle assemblages and pollen profiles, and the problems of errors in radiocarbon dating and variations in statistical approaches to pollen data, followed in his closing remarks.

W. R. Farrand (University of Michigan, Ann Arbor) reported on climatic changes in the Near East during the last glaciation. He used evidence from prehistoric rock shelters, colluvial bodies, chemical weathering, distribution of fauna, and limestone rubble deposits to substantiate a cool and wet climate during the first half of the last glaciation, and a cool and dry one during the last half. Further evidence for this dry phase is shown by a reduction of arboreal pollen in northern and eastern parts of the region. A. Roberts (York University) reviewed the archaeological record in Southern Ontario from circa 12,000 BP to European contact period. He stressed the correlation of Archaic artifacts and the development of mixed-hardwood forest during the period of climatic amelioration (9,000 to 5,000 BP) which is supported by pollen and Coleoptera records. G. A. Wright and S. A. Reeve (S.U.N.Y., Albany) described climatic change in northwestern Wyoming from 11,000 years ago to present, and the effects of environmental changes on prehistoric land use patterns. Changes in timberline elevation, movement of mountain glaciers and changes in forest compositions were discussed within the context of human land use patterns.

On May 20, A. V. Morgan led a field trip to the Don Valley Brickyard and Scarborough Bluffs to view the sequence of late-Quaternary deposits and to study the mid-Wisconsin beds and fossil content.

The proceedings of the symposium will be published as *Quaternary Paleoclimate* by Geo-abstracts Ltd., Univ. of East Anglia, Norwich, U.K., at a price of £12. Abstracts and field guide from the symposium can be obtained from W. C. Mahaney at a price of \$3.00.

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Faculty Positions Department of Geology University of Windsor

Applications are invited for two tenure-track positions at the Assistant Professor rank in the following fields:

1. Paleontology-Biostratigraphy, and
2. Engineering Geology - Geotechnical Engineering.

Applicants with expertise in closely related applied geological disciplines (e.g., paleoecology, petroleum geology, rock mechanics, clay mineralogy and oxygen isotope geology) are encouraged to apply. They should hold a doctoral degree or anticipate receiving it near the time of commencement of the positions on July 1, 1980. Both positions involve teaching at the undergraduate levels as well as conducting a research programme involving undergraduate and graduate thesis students. Salary will depend on the applicant's experience in teaching, research and industrial experience and will be in the range of \$20,000 to \$25,000. Send a curriculum vitae and the names and address of three referees to:

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Mineralogical Association of Canada Short Course: Neutron Activation Analysis in the Geosciences

A Short Course on Neutron Activation Analysis (NAA) in the Geosciences, sponsored by the Mineralogical Association of Canada, will be held at Halifax, N.S., during 16-18 May, 1980. It immediately precedes the annual meetings of the Geological and Mineralogical Associations of Canada in Halifax during 19-21 May, 1980.

Intensive lecture sessions, demonstrations, discussions and exhibits are planned on: Development and present status of NAA; general principles; neutron sources; γ -ray detectors; data acquisition and reduction; instrumental and radiochemical methods; applications to mineralogy, petrology, subsurface mineral exploration, and environmental studies. The course is designed to provide an overview for those who are not experts in the methods.

Further information and registration forms may be obtained from:

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