

to the east and 10° of latitude farther to the south. This latter finding probably can be linked to the prevailing wave pattern of atmospheric circulation and to the related position of the circumpolar discontinuity between polar easterlies and subpolar westerlies.

The figure suggests that the area in which annual temperature varies in the same rhythm is relatively small. This agrees with the results of an analysis of all temperature records available since 1957, which unfortunately do not include any coastal station between 170°E. and 70°W. Within this period, only 1960 shows all 16 stations south of 65° with below normal temperatures; in that year the temperature at Orcadas was above normal, and the duration of ice in Scotia Bay was only 75 days.

This research was supported by National Science Foundation grant GV-28810. Thomas R. Karl made most of the computations.

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## Numerical calculation of ice deformation

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Computer programs are being developed for numerical calculation of deformation within glaciers and ice sheets. The finite element method is being used; this method has the advantage that a single program can handle problems involving complex boundary shapes, various assumptions concerning the form of the flow law, and spatial distribution of flow law parameters such as temperature. Also, such a program can be used by people who are not familiar with the details of numerical solution of partial differential equations.

Programs for two simplified types of flow geometry are being developed. One is applicable when the flow is basically rectilinear, as would be the case when longitudinal gradients of velocity and stress are negligible. This program is now operational and includes efficient routines for convenient input and graphical display of results. The second is applicable when the flow is planar and longitudinal gradients of velocity and stress

are of major importance. Although the programs are functional, we are making improvements necessary for effective application to practical problems. Both programs are being made as system-independent as possible so that other glaciologists can use them on other computers with only minimal modifications. We are not attempting to develop a general program for fully three-dimensional flow, because the application of such a program to practical problems would require unreasonably large amounts of computer space and time.

The programs have not yet been applied to problems of specific interest in Antarctica, but once completed they can be used for detailed analysis of a variety of problems. Some examples are deformation at the margins of an ice sheet, at the grounding line between grounded ice sheet and floating ice shelf, or at a transition from slip to no-slip basal boundary conditions. The programs will make possible detailed and accurate calculation of effects from longitudinally or laterally varying bed topography. Calculation of deformation in ice shelves lying within complicated embayments represents another attractive potential application.

This research was supported by National Science Foundation grant OPP 74-19075.

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## Analysis of permafrost cores from antarctic dry valleys

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Multidisciplinary laboratory investigations of dry valley permafrost cores are being carried out at the Quaternary Research Center to help determine depositional environments and glacial history represented by the recovered sediments. The cores were collected during the Dry Valley Drilling Project. Primary emphasis has been placed on studying the long cores from lower Taylor Valley, where terrestrial and marine sediments appear interstratified. Principal studies concern micropaleontology, oxygen isotope analysis, sedimentology, and stratigraphy.

*Hole 3, Ross Island (micropaleontology).* H. Y. Ling examined 19 samples. Radiolarians were observed