GENERAL SCIENCE NOTES

PRECAMBRIAN AND PALEOZOIC GLACIATION?

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The slow but powerful action of glaciers has fascinated man for centuries. The work of glaciers and the characteristic landscape features left by the movement of these huge quantities of ice has been the subject of considerable investigation. As a glacier retreats it often leaves a number of tell-tale signs of its past presence. These include hanging valleys perched high above other large carved U-shaped valleys, till (pieces of unsorted ground rock) deposited below or along the sides of a glacier in the form of ground or lateral moraines (Figure 1), striations (scratches) and polish left by the grinding action of ice and rock and a host of other features. Some of these characteristics are used to tell where a glacier may have been in the past, even though no ice is present now.

Numerous deposits of reported glacial origin are observed throughout the geologic column. Their presence can significantly affect one's interpretation of the amount of time involved in deposition. Most familiar are glacial deposits associated with the more recent and surficial "Pleistocene ice age"; however, of special interest are very ancient Precambrian and Paleozoic deposits which are attributed to previous glacial activity. Presumed very ancient glacial deposits are reported from every continent. Two examples are the Precambrian Kingston Peak formation near Death Valley, California, and "Reusch's moraine" in Norway. Glacial features such as tills, glacial pavement with striations, and faceted and striated boulders are generally presented as evidence. Are other interpretations (non-glacial) of the data justified? Some researchers say "yes."

Dunbar (1940) questioned the glacial origin of the Carboniferous tillites (cemented till), striated boulders, and glacial pavement of San Juan, western Argentina. He concluded that the regional geology indicates that the striated pavements were slickensided fault surfaces, and the striated pebbles and tillites were the result of landslides and mudflows.

It has been suggested (see Lakshmanan 1969) that the Precambrian (Vindhyan) deposits in central India are of glacial origin. However, Lakshmanan states that "the evidence offered for Vindhyan glaciation are disputable and wholly unconvincing." He concludes that: 1) the tillites

FIGURE 1. View of Athabasca Glacier located in the Canadian Rockies. The glacier originates from the Columbia Ice Field located beneath the clouds in the background. The glacier flows down over several bedrock steps giving a staircase appearance to its upper flow. Thickness of the glacier is up to 300 m. At present the glacier is moving at an average rate of about 6 cm per day, but since it melts faster than that, its toe is retreating at the rate of approximately 12 m per year. This retreat exposes some typical glacial till deposits such as ground and terminal moraines in the foreground in front of the toe of the glacier and lateral moraines along the sides. In this photograph the darker debris at the sides of the glacier is rock material covering up the ice at the edge of the glacier. A good lateral moraine can be seen at the left of the glacier. It is steeper than the rock debris described above and lighter in color, with small buildings on top.

could be mudflow deposits and, 2) the mudcracks, ripple marks, rain-print impressions, stromatolites and limestones are generally associated with warm climates.

Newell (1957), after examining reported Permian tillites in northern Mexico, concludes that the "Mexican boulders and volcanic rocks most probably are submarine slide deposits...."

The presence of striated pavement may at first seem to be solid evidence for glacial activity. Crowell (1963) proposed that the striations present in the quartzite underlying Reusch's moraine in Norway may have formed when the pebbles in subaqueous mudflows or slumps were

impressed into soft sand. The presence of a pebble at the end of a striae impressed into the quartzite was noted.

Not all glacier-like features can be attributed to geologic causes. Berkland & Raymond (1973) reported Pleistocene glaciation in the southern Appalachian mountains, North Carolina. However, their evidence was disputed by Hack & Newell (1974), who commented that the "grooves" were "made by moving cables used in logging operations." McKeon (1974) also agrees that they are man-made rather than glacial.

These examples indicate that geologic features which resemble those associated with modern glaciers may be formed by mechanisms other than ice. Crowell (1963) examined the geologic processes that could account for such similarity; his list includes slumping, mud-flows, turbidity currents, giant slide blocks, volcanic lahars, talus debris, and weathering of conglomerates. Presently, much controversy still exists over the glacial origin of some ancient deposits. Alternative geologic processes are numerous and at times not completely understood. The mechanism, whether it invokes unusual events such as giant tides or persistent freezing weather, is of significance to our understanding of earth history.

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