Steele Glacier Surge

WALTER A. WOOD

FROM time to time dramatic natural events occur which overflow the frontiers of scientific concern and attract the attention and interest of a broad segment of the lay community. Earthquakes, volcanic eruptions and avalanches are eye-catching examples, largely owing to their effects on man and his works. No less dramatic, though happily less destructive to human developments, is the phenomenon to which the euphoneous term "galloping glacier" has been attached. In recent years a number of glaciers have experienced rapid acceleration in their rates of flow, and a few words on their behavior may be of interest to mountaineers.

It is generally recognized that, in mountain glaciers, ice flows in response to the mass of ice involved, gravity, and the slope of the glacier bed. What might be called "normal flow" continues as long as the glacier receives sufficient nourishment in the form of snow to sustain its advance. If nourishment increases or decreases — and this is usually due to variations in climate — the behavior of the glacier will be affected accordingly.

Worldwide interest in glaciology has focussed scientific attention on an increasing number of glaciers; and it has become recognized that climatic influences are not uniquely responsible for the acceleration of flow that has taken place in a number of glaciers, notably those in northwestern North America. Here certain glaciers have been observed to be advancing throughout a spectrum that might be said to range from "sustained accelerated flow" to "catastrophic surges" of ice. A major contribution to our knowledge of these advances has come from the work of Austin Post and Mark Meier of the United States Geological Survey at Tacoma, Washington, and their conclusions may show that surges are not as uncommon as they have been believed to be. Indeed, they may occur periodically in certain glaciers.

Of all forms of accelerated advance, the "catastrophic surge" is the most dramatic. Here a pent-up imbalance within the glacier is suddenly released and the entire body of ice is converted from a state of relatively sedate behavior into a chaos of rapidly advancing ice. In 1966, it was the good fortune of the Icefield Ranges Research Project (Arctic Institute of North America — American Geographical Society) to observe and to initiate studies of a glacier of the St. Elias Mountains during the full flood of a catastrophic surge. The glacier in question, Steele Glacier (formerly Wolf Creek Glacier) drains the eastern slopes of Mount Steele (16,644 feet), flows northward and eastward for some 22 miles, and discharges its melt-water into the Donjek River, a member of the Yukon River system.

The recent history of Steele Glacier is well known. It was first visited by the American Geographical Society's Yukon Expedition of 1935 which established a network of survey stations along its margins from which photographic panoramas were exposed. These panoramas were repeated in 1939, 1941, and 1947. In 1951 and 1956 air mapping photography was exposed over Steele Glacier by the Canadian Government, and its surface features have been well illustrated over the last 30 years by Post, Washburn, and Wood. The geology and glacier geomorphology of the Steele Glacier were studied in 1941 and reported by R. P. Sharp.

The current surge was observed in its early stages by Post during the late summer of 1965, and "rediscovered" in July of 1966 by Philip Upton, chief pilot of the Icefield Ranges Research Project. A field camp was established at the margin of Steele Glacier, in mid-course, in late July. Using a helicopter, supported logistically by the IRRP Helio Courier fixed-wing aircraft, the field party reoccupied ten photo survey stations and determined the velocity of flow at the margin of the ice mass to be of the order of two feet per hour (1500 feet per month). Prior to the surge, surface movement is estimated to have been in the three-feet per month range in mid-course.

Little is known of the causes of catastrophic surges. Indeed, the 1966 field party was the first to observe and initiate studies of a surging glacier in North America. From the vantage point of a slow moving helicopter it was possible to examine features of the chaotic ice of Steele Glacier throughout its length. Most striking to the aerial observer was an obvious downward vertical displacement of the entire glacier surface near the 8500-foot level at the base of Mount Steele. The slump was measured by helicopter altimeter to be 240 feet. Downstream from this area blocks of stranded ice formed "Chinese Walls" at least 150 feet above the general surface of the surging glacier and more than 200 feet above the level at which active ice has been known to exist in modern times. Thus, it appears that the basal ice of upper Steele Glacier was triggered into sudden and rapid motion. This created a physical wave of ice that washed against the retaining valley walls and, having passed downstream, left remnants of its passage along the marginal slopes. Some impression of the power of the surge was dramatically illustrated ten miles below the base of Mount Steele. Here a tributary glacier had, in the late 1930's, thrust its ice into the mainstream of Steele Glacier nearly to the axis of the mile-wide valley. This protruding lobe had been as cleanly decapitated by the surging ice as though a knife had passed through a pad of butter. The lobe itself, little deformed, and weighing possibly 75,000,000 tons, was easily identified some three miles downstream!

At the time of the 1965 surge, the ice of the lower eight miles of Steele Glacier was virtually stagnant, but by mid-September 1966 the surging ice had advanced to a point barely three miles above the terminal moraine built by the last major advance of about 100 years ago. The active terminus was advancing at a rate of 1200 feet per month.

The Steele Glacier surge will run its course, probably during 1967. Meanwhile, and for some years to come, it provides a natural laboratory for scientific study from which will emerge, hopefully, enhanced knowledge of the dynamic and mechanical processes of glacier behavior.