

LEWIS GLACIER 1983, MOUNT KENYA, 1:5,000

(Terrestrial photogrammetric map)

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The terrestrial photogrammetric survey for a map of Mount Kenya was carried out by E. Schneider in 1963 (Schneider 1964). On this basis, a contour-line map of Lewis glacier was drawn at a scale of 1:2,000, which later turned out to be too inaccurate for calculations of volume changes. The terrestrial photogrammetric field survey was therefore repeated in 1983 in order to enable a new contour-line map to be produced using the original photo plates of 1963. The new map was corrected and completed in critical areas with the aid of photographs taken in 1983. This procedure made it possible to significantly improve the topographical base material for calculations of volume changes and also for the extensive glaciological research work which had started in the meantime (Hastenrath 1984).

The present map has been compiled from the 1983 photographs (Patzelt et al. 1984). The photogrammetric survey was carried out on 25 February, 1983 using a TAF-Photo-Theodolite and four base-lines allowing for a 100%-coverage of the glacier area. Triangulation was connected to the fixed points of the IGY-survey net which had been used by all previous geodetic surveys since 1958. The snow-free glacier surface rich in structural details presented an ideal prerequisite for an analysis at a scale of 1:2,500. Reduction to a map scale of 1:5,000 did not introduce any loss of information.

Cartographic processing aimed at realistically representing not only the glacier but also its surroundings and the glacier forefield. In line with naturally-occurring differences in colour, bedrock areas are marked with a darker grey tone as compared to the lighter scree surfaces. Rock signatures emphasize the contrast between the sharp periglacial crests and walls, and the polished and rounded forms in formerly glaciated areas. Morainic ridges within debris-covered slopes are indicated by the arrangements of dots and by edge-marking symbols pointing to the steeper, inner side. A blue dashed-dotted line gives the position of ice margins for five earlier glacier stages. The stages 1 and 2 are not dated but can be attributed to advance periods of modern times since

soil development is weak and vegetation cover is thin. Stage 3 marks an advance moraine from the time period around 1890 A.D. The ice margins of 1934 and 1950 have been determined by the corresponding maps of those years. The dotted blue line at Curling Pond indicates the extent of the lake in 1963.

Crevasses on the glacier surface were mapped carefully in their actual positions. They reflect the conditions of glacier flow. The crescent-shaped crevasses near the margins of the glacier tongue point to the impending collapse of the ice surface - an event which has since taken place (1986). Exact delineation of ice within the debris-covered part of the glacier below Pt. Thompson is not possible; the map probably gives a minimum rather than a maximum extent. (Melhuish glacier, for instance, had already completely vanished by 1983.)

The contour-line maps of the years 1978, 1974 (Hastenrath 1984), 1963, and 1958 could be fitted without problems to the 1983 map. For the glacier stage in 1934, only the glacier boundaries could be taken from the map by Troll and Wien (1950); the surface of the glacier in 1934 had to be reconstructed. The same holds true in the cases of glacier stages 1, 2, and 3. The numerical values given for these stages are thus approximations only.

Surface areas ( $F$ ), changes in surface area ( $\Delta F$ ), volumes ( $V$ ), changes in volume ( $\Delta V$ ) and changes in mean ice thickness ( $\Delta h$ ) for 1934, 1958, 1963, 1974, 1978, and 1983 are given in Table D of the present volume. The table at the end of the present map text summarizes the values for the entire glacier, including the earlier glacier stages 1 to 3 (the 1978 volume is from Bhatt et al. 1981).

The rather small differences with respect to the numbers presented by Hastenrath (1984) can be explained by the improved map of 1963 and by differing interpretations of debris-covered ice near Pt. Thompson. Between 1963 and 1983, Lewis glacier decreased by 22% in surface area and by 50% in volume. The highest loss in ice thickness since about 1890 occurred during the 1974 to 1983 decade when the glacier surface lowered at a rate of more than 1m per year. On average, the equilibrium line has been close to 4800m a.s.l. over the past few years. For a zero-mass balance, however, it should be lower by 50 to 60m. The glacier tongue

still appears to be too large given today's accumulation conditions, and should supposedly continue retreating in order to reach a steady state. Recent photographs taken in 1986 confirm that such a change is indeed happening.

Table:

glacier stage	F 10 <sup>4</sup> m <sup>2</sup>	Δ F 10 <sup>4</sup> m <sup>2</sup>	V 10 <sup>6</sup> m <sup>3</sup>	Δ V 10 <sup>6</sup> m <sup>3</sup>	n (years)	Δ h (m/y)
1983	28.37		4.69			
		- 2.71		- 1.51	5	- 1.02
1978	31.08		6.20			
		- 1.02		- 1.38	4	- 1.09
1974	32.10		7.58			
		- 4.45		- 1.69	11	- 0.44
1963	36.55		9.27			
		- 1.54		- 0.91	5	- 0.49
1958	38.09		10.18			
		-11.65		- 6.50	24	- 0.62
1934	49.74		16.68			
		-11.87		- 7.56	ca. 14	ca.- 1.0
1920 (ca.)	61.61		24.24			
		- 1.92		- 1.80	ca. 30	ca.- 0.1
St.3 "1890"	63.53		26.04			
		- 5.25		- 4.24		
St.2	68.78		30.28			
		- 3.01		- 0.47		
St.1	71.79		30.75			