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A NOTE ON THE PREVALENCE OF THE KATABATIC WIND OF ANTARCTICA

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The slopes of the Antartic ice plateau present the best known conditions for the development of a katabatic wind, providing a long fetch with a smooth surface and strong cooling. The resultant wind on certain parts of the coast is probably the strongest on the earth's surface (a mean of 45 m.p.h. for two years was measured at Cape Denison).

Places where the katabatic wind is well developed are the coast and inland slopes at Mawson, Mirny, Wilkes and Adelie Land, and the Prince Olav Coast near Syowa. All of these are mentioned in "Antarctic Meteorology - Proceedings of the Symposium held in Melbourne, February 1959". They are all areas where there is a suitable ice slope, of the form characteristic of the ice sheet where it slopes down to the sea, and it seems reasonable to argue that the katabatic wind and the ice-slope will always be found together.

Dzerdzeevskii, in his symposium paper(p. 37)raises the question of the size of the area affected by the katabatic wind, and summarises his argument thus: "Strong downslope seaward winds are in no way a regular feature of the whole coastal area of Antarctica. They are peculiar only to certain sections which are, most often, only short stretches of coast. In other (even neighbouring) regions, landward winds are predominant. The overall mean wind velocity in the first case is greater than in the second".

ANARE field trip observations show a katabatic wind from at least Scullin Monolith to King Edward VIII Bay, a distance of about 300 miles, which is hardly a "short stretch". Loewe (Antarctic Meteorology p. 365) gives the approximate length of the ice-wall (at the foot of the typical katabatic-type slope) as 11,000 km, and the length of shelf-ice and glacier coast combined as about 8,500 km. Adding mountain coast to the latter, it seems that roughly half the Antarctic coast should be subject to the katabatic wind.

The area of plateau under the katabatic wind must also be quite large. On the meridian through Mirny, the katabatic wind is already well-established at Pioneerskaya, 335 km from the coast (Tauber, on p. 62 of Antarctic Meteorology). If this meridian is typical, which seems likely because it is topographically almost featureless, and taking the length of the katabatic slope as 500 km in round numbers, a very rough calculation makes the katabatic slope about 25 per cent of the area of East Antarctica. Observations inland from Mawson show downslope winds up to 400 miles inland (Mather, Antarctic Meteorology p. 317 and Shaw, Aust. Met. Mag. No. 18, Sept. 1957), the direction of the wind being determined by the direction of greatest slope of the plateau surface and the Coriolis effect. Mather suggests that in the katabatic zone, wind direction and therefore orientation of sastrugi could be used as indicators of plateau topography.

Dzerdzeevskii emphasises variations of coastal wind and climate, and in particular the importance of the general circulation in determining wind velocity near the coast. It is the only important factor on the half of the coastline where the katabatic wind does not operate, and also more than a few miles seaward from the ice-foot, as shown by his micro-analyses of observations from closely-spaced stations on or near the coast. However, all the observations that he uses from stations on the ice slope, or at its foot, show a katabatic wind, and his conclusion that absence of downslope flow is characteristic of the Prydz Bay area (p. 43) seems misdirected, since the coast of Prydz Bay is largely shelf-ice and exposed rock "oases", and the downslope itself is absent except on parts of the east side of the Bay where no observations were made.

Variations of the katabatic wind along the coast have been observed (Shaw, Antarctic Meteorology, p. 7) and given a theoretical explanation in terms of topography by Ball (Antarctic Meteorology, p. 9).

The general circulation certainly affects climate other than wind. Mawson, for instance, appears to be in a region of low cloudiness and precipitation compared with other parts of the coast. It also appears to control to some extent the wind velocity on the greater part of the ice-plateau, where the slope is not sufficient for a katabatic wind to develop.

Another interesting effect of the general circulation is on the katabatic wind itself in a strong cyclone. During the passage of a deep depression north of Mawson, the wind direction changes through about 50 degrees (110^{o} to 160^{o}) and at Mirny, through 70^{o} or more. This is much less than the 140^{o} which might be expected in the absence of local effects, but greater than the variation derived theoretically by Ball (Antarctic Meteorology, p.14) for a layer of cold air. Ball gives an explanation of the considerable effect that a depression has on the speed of the surface wind, but deduces little effect on direction. This may be because the assumption of an inversion or stable layer above the katabatic stream breaks down in a strong cyclonic situation, when the wind speed increases with height.