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LETTERS TO THE EDITOR

Comment on "Late Quaternary Climates of Australia and New Guinea" by J. M. Bowler, G. S. Hope, J. N. Jennings, G. Singh, and D. Walker

In their recent review of late Quaternary climates of Australia and New Guinea, Bowler *et al.* (1976) acknowledged (p. 359) that their task was to "attempt to integrate findings from many climatic zones." It therefore is regrettable that they failed to discuss the possibility of climatic variation at certain times between Australia's southern marginal areas and areas some 400–900 km to the north within the presently arid continental core. In South Australia there is good evidence that such climatic differentiation indeed occurred between 40,000 and 30,000 years BP and during the Holocene.

(1) *40,000 to 30,000 years BP.* The alluvial Pooraka Formation, dated at >37,800, $34{,}600 \pm 2700$, and $33{,}270^{+2130}_{-1680}$ years BP (Williams, 1969, 1973), provides evidence of a northward change in effectiveness of precipitation and possibly also in rainfall distribution pattern during mid-Wisconsinan time. In the Adelaide area, alluvial-fan deposits of this formation comprise mainly channel sands and gravels and overbank clays (Twidale, 1968, pp. 391–393; Williams, 1969), in a type area containing abundant fragments of carbonized wood (Williams, 1969). In the northern Flinders Ranges 400–500 km to the north, by contrast, the Pooraka Formation of the fans is characterized by mud-flow deposits typically barren of vegetative matter (Williams, 1973). This northward change in character of piedmont sediments and the accompanying apparent reduction of vegetative cover within catchment areas are reasonably interpreted as reflecting a change from relatively "humid" conditions in the south to a drier climate with episodic high rainfall in the north. As concluded by Williams (1973, p. 120), mid-Wisconsinan conditions in the northern Flinders Ranges appear to have been relatively dry, with bare slopes mantled by unstable debris which slumped into the main canyons and spread over the fans as mud flows during brief episodes of intense precipitation. Such a rainfall distribution pattern, accompanied by substantially reduced temperatures, may help explain the evidence from southeastern Australia (e.g., higher groundwater and lake levels; Bowler *et al.*, 1976, p. 385) that precipitation during this period was more effective than that of today.

(2) *Mid-Holocene.* A Holocene piedmont alluvial terrace at and south of Adelaide typically is dark gray to black in color and contains much humic clay and fragments of carbonized wood [this formation is the Walkerville Sand of Twidale (1968) and the Waldeila Formation of Ward (1966), dated at 7510 ± 150 and 5860 ± 65 years BP (Williams, 1973)]. Correlative piedmont alluvial terraces in the northern Flinders Ranges (Members 1 of Thompson Creek Formation and Eyre Gravel, middle and uppermost levels of which are dated at 6000 ± 100 and 5130 ± 100 years BP, respectively; Williams, 1973) are red to light-reddish brown in color and contain no humic clay and little vegetative matter. The inferred northward changes in soil type and vegetative cover within the catchment areas are consistent with decreasing "humidity" progressing northward into the continental

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interior. The Eyre Gravel and the Thompson Creek Formation appear to have been deposited by flashy stream discharges higher than those of today in an overall arid to semiarid climate (Williams, 1973, pp. 106, 121). It is surprising that Bowler *et al.* (1976, p. 388) should consider evidence from far distant areas such as Keilambete and Gnotuk in western Victoria, Wilsons Promontory in southernmost Victoria, and Western Australia as pertinent to the Holocene climate of the northern Flinders Ranges in South Australia, with scant reference to previous work in the Mount Lofty Ranges–Flinders Ranges chain (e.g., Ward, 1966; Twidale, 1968; Williams, 1969, 1973; Williams and Polach, 1971).

In conclusion, I consider that there is no reliable evidence that the northern Flinders Ranges had, during important episodes of late Quaternary piedmont alluviation, truly "humid" climates as interpreted for the marginal areas of southern and southeastern Australia. It is to be hoped that future syntheses of Australia's late Quaternary climates will pay more attention to the problem of climatic variation within the continent.

REFERENCES

Bowler, J. M., Hope, G. S., Jennings, J. N., Singh, G., and Walker, D. (1976). Late Quaternary climates of Australia and New Guinea. *Quaternary Research* **6**, 359–394.

Twidale, C. R. (1968). "Geomorphology." Nelson, Melbourne.

Ward, W. T. (1966). "Geology, Geomorphology, and Soils of the South-western Part of County Adelaide, South Australia." Soil Publication No. 23, Commonwealth Scientific and Industrial Research Organization, Australia.

Williams, G. E. (1969). Glacial age of piedmont alluvial deposits in the Adelaide area, South Australia. *Australian Journal of Science* **32**, 257.

Williams, G. E. (1973). Late Quaternary piedmont sedimentation, soil formation and paleoclimates in arid South Australia. *Zeitschrift für Geomorphologie* **17**, 102–125.

Williams, G. E., and Polach, H. A. (1971). Radiocarbon dating of arid-zone calcareous paleosols. *Geological Society of America Bulletin* **82**, 3069–3086.

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Reply to Comment by G. E. Williams

Our critic misses the point of the exercise and faults us for failing to do a task we did not set ourselves. Although it is desirable to determine the pattern of climate in Australia at different times in the Late Pleistocene, the empirical evidence for doing so is still inadequate even though we admit the value of hypotheses generated from the data already available (Bowler *et al.*, 1976, p. 384). What we attempted was to bring together the evidence for temporal change in climate, almost entirely in relative terms, for different parts of the continent and then to make comparisons between these time sequences. While we did not try to draw out from the commonly meager data the geographical variation to which Dr. Williams soundly draws attention in the case of South Australia, there is no implication in our text of uniformity of climate at any given time over the continent as a whole or in segments the size of states; the division of the paper into sections dealing separately with five zones within Australia is itself evidence of this.

We assumed two principles: (1) The identification of Pleistocene environmental changes may best be pursued in the framework of modern climatic zones. (2) Within any one of these the influence of changes may reasonably be expected to extend throughout. While the magnitude may differ from place to place, the overall trend may be similar.

When we made comparisons between the northern Flinders Ranges and distant parts of southern Australia, they were directed at the sense of change rather than at its

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