Climate and landforms

Robert P. Beckinsale

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THROUGHOUT the twentieth century the direct and indirect influence of climate on the shapes of landforms has been generally admitted, and the cult of distinctive landforms in distinctive climates has become a hallowed geographical tradition. There is much in its favour because the characteristic landforms in cold glaciated lands, hot deserts and humid tropical regions seem to differ markedly from each other. So climatic geomorphology grew up as a zonal concept wherein each broad thermal belt tended to develop its own specific complex of dynamic processes. Climate was exalted as the great panjandrum, the universal supplier of solar energy and the creator of kinetic energy for the moisture machine. Climatic geomorphologists seemed to be overriding the doctrine of James Hutton:

> "Our land has two extremities; the tops of the mountains, on the one hand, and the sea shores, on the other: —While there is a sea shore and a higher ground, there is that which is required for the system of the world: Take these away, and the world would remain an aqueous globe, in which the world would perish."

Yet it is obvious enough that before climate can work on rock surfaces, some of the latter must be raised above sealevel; once exposed they will probably consist of differing geological compositions which will withstand the attacks of weathering and erosion in different ways and at different rates. Most landforms must be considered to represent the interactions of their structure, stability relative to base level, the processes at work on them past and present, and the length of time for which those processes persisted. The complex nature of each of these parameters and the multitude of possible combinations of their variables ensure as regards surface shapes—or slopes, or whatever is meant by morphometry—that all forms of hillslope occur in all climatic environments.

The scientific analysis of the shape and spatial distribution of landforms is an enormous task still largely uncompleted yet it forms the basis of early climatic geomorphology. The later or latest trend is to determine the exact cause and rate of the climatic process, and in turn to determine the relative importance of each major component of climate. At the same time the relative importance of the passive parameter, the rock structure, may also be revealed.

It is in this spirit that *Geomorphology and Climate* presents an analysis of the interactions between climatic processes and the shape of landforms. Written by fifteen well-known authors from Australia, Europe and North America, it can safely be said to be authoritative and certainly is neither dull nor dogmatic. It opens with a broad survey of the problems on the assumption that the central concern of climatic geomorphology lies in the extent to which variations in the elements of climate are reflected in geomorphic processes to produce distinctive suites of landforms. After a discussion of the traditional approaches by way of broad zonal patterns based largely on climate, vegetation and soils, the evidence of surface shape is shown to be inadequate as the sole basis for testing the influence of climate on landforms.

The following six chapters proceed in a logical sequence to discuss climatic interactions involved in rock weathering, mass wasting and the development of soil catenas and slopes. As would be expected of these experienced campaigners, the approach is modern, thorough and objective. For example, we learn that attempts to classify mass-movement types and frequency and their role in landscape development in terms of climatic parameters are doomed to failure; that, except in extreme situations, it is premature to relate climatic–geomorphological systems to soils; and that at medium or regional scales, slope forms cannot usefully be viewed as responses to climatic variables alone.

The next four chapters deal with water in hydrological slope models, with fluvial erosion rates, drainage networks, and, using West Malaysia as a detailed case study, with the role of climate in denudation. In these fields the influence of climate seems to be more securely established. For example, although several of the interactions are poorly understood and much more practical measurement is needed, the present findings and models of hydrological slopes are 'reasonably acceptable' and, moreover, within morpho-climatic zones the values of drainage density do reflect the climate.

Inevitably the discussion then turns, in chapters 12–14, toward lithology, which provides the framework and constraints in which climatic influences bring about the nature and rate of weathering, denudation and erosion. There seems to be no doubt that geological factors may become dominant on a small scale and tectonic factors on a somewhat wider scale. The relative importance of rock composition is analysed with particular reference to granites, limestone, sandstones, schists and basalt. Just as the use of standard climatic means is being replaced by that of more pertinent extremes, so the use of crude rock types is being refined by the subtleties of microscopic analysis of rock composition and texture.

The concluding chapter gives a nicely rounded account of climatic factors in cirque formation. Not surprisingly, as cirques are often partly inherited from a pre-existing fluvial system and have close relationships to faults, the authors found it difficult to make generalisations on cirque variations in relation to climate.

This excursion to the snowline inadvertently draws the reader's attention to the absence of chapters on glacial, periglacial, and arid geomorphology. But the editor has already explained this omission. In his opinion, large-scale global, zonal or regional groupings, known as climatic geomorphology, reached their acme in 1950–65 and probably cannot profitably be taken much further until their broad assumptions have been fully tested by establishing the precise relationships between landform shapes and climatic parameters. Consequently this text *is* on geomorphology and climate.

Bear in mind, however, that in landform evolution the present dynamic processes are often not the key to the past, and that, as an American wit said, the landscape has been out of doors a long time. Because of wide swings in climatic zones during the Quaternary and the remarkable survival and reappearance of relic features from the more distant geological past, over large areas the present landforms are partly a product of past processes. But present processes do, however, provide the key to present denudation and therein lies much of the value of this collection of essays. An understanding of geomorphic processes and of their influence on the existing landscape is essential to Earth Sciences in an age when man's disturbance of the natural environment has become excessive. Consequently the advances in knowledge and experimental techniques discussed here are to be welcomed, especially as the clear exposition and frequent diagrams make them readily intelligible. □

Robert Beckinsale is an Emeritus Leverhulme Fellow and Supernumerary Fellow of University College, Oxford, UK.