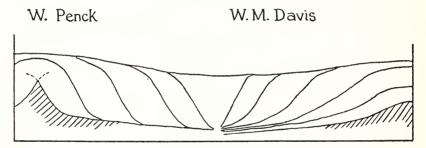
The Misleading Antithesis of Penckian and Davisian Concepts of Slope Retreat in Waning Development

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In the last thirty years or so, geomorphologists have shown intermittent but lively interest in the problem of slope development. A segment of this large and difficult problem has taken the form of a controversy, sometimes phrased rather loosely as follows: under the condition of a stable base of erosion, does the valley slope retreat parallel to itself or does its inclination decline with age? The former position is attributed to W. Penck and the latter to W. M. Davis. The presumed contrast in slope forms resulting from these concepts is illustrated by Davis in a simple diagram in his paper on "Piedmont Benchlands and the Primärrümpfe" (1). This diagram (Fig. 1) has



after Davis

Figure 1.

been reproduced, and served as a basis for discussion, at least three times. It appears, for example, in the symposium on W. Penck held by the Association of American Geographers in 1940 (2), in C. A. Cotton's popular textbook "Landscape" (3), and, more recently, in L. C. King's paper on the "Canons of Landscape Evolution" (4).

Davis's diagram served to emphasize the opposition between Davisian and Penckian concepts of slope retreat. His simplified presentation tends to mislead because it neglects an important implication in Penck's analysis; namely, during waning development (absteigende Entwicklung), only the cliff or rock wall (Steilwand or Felswand) of the valley slope retreats parallel to itself. The valley slope as a whole becomes concave and its gradient declines in a way similar to Davis's own conception (5). The cliff (A, B, or A_5 , C_5 in Fig. 2) is assumed at the beginning of Penck's deductive treatment in order to allow graphic presentation. If one starts the analysis with a valley slope of gentler inclination than the cliff, as, for instance, the slope B, D_n , C_n in Fig. 2, then the subsequent stages of slope flattening become almost identical

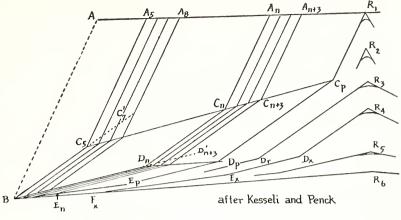
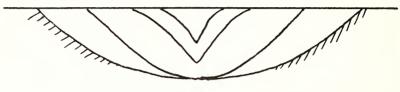


Figure 2.

with those conceived by Davis. The slope B, Dn, Cn is a smooth, concave curve. The break of slope in the valley side occurs only at the junction between the cliff (Steilwand) and the uppermost segment of the denudational slope (Haldenhang), along the line C₅, C_p where there is a change in transportational process from free fall to creep, sliding and rainwash. The denudational slope below the cliff is a smooth curve, since a, the inclination of each segment of the denudational slope is determined by the mobile size of the debris, which shows a smooth gradation; b. as soon as the Haldenhang appears beneath the receding cliff, processes of denudation would operate to produce a gentler subjacent slope segment. In Fig. 2, on the other hand, a slope segment of gentler inclination than the Haldenhang is assumed to appear only after five units of time have elapsed. The Haldenhang is thus drawn as a straight line that meets lower and gentler slope segments, also represented as straight lines, at distinct breaks. This departure from logical rigor is inherent in the graphic method of analyzing continuous and simultaneous processes.

Davis's diagram further stresses the contrast between the Penckian and Davisian concepts of slope retreat by his presentation of their views on the development of the crests of the interfluves. According to Davis, the crests of the interfluves become broadly convex in the late stages of the cycle (Fig. 1). Penck, on the other hand, argued for the prevalence of concave slopes in waning development. But he did not conclude that the residual hill should be a sharp peak as Davis depicted it in his diagram. Penck recognized and attempted to explain the rounding of hill-tops independent of his premise on rates of uplift (6). Hence the difference in viewpoint between Penck and Davis regarding the curvature of interfluves in waning development narrows down to a difference in the length of the convex arcs when the valley slopes are seen in profile. Recent observations by King and Sharp suggest that Davis has exaggerated the length of the convex arc in a region of waning development (7). The convolute prose of Penck's treatise, "Morphological Analysis of Land Forms," is well known. His arguments are not always complete and are invalid in places. Some of Penck's statements regarding slope development have been expanded and lucidly re-stated by J. E. Kesseli (8). A careful reading of Penck's works shows that his concept of slope retreat in waning development differs less from the view expressed by Davis than is sometimes supposed. Thus in a paper on "The Piedmont Benches of the Southern Black Forest," published posthumously in 1925, Penck (9) has a simple sketch (Fig. 3) that



after W. Penck

Fig. 3

illustrates the gradual flattening of a valley slope in the true Davisian manner. Davis, on his part, has modified his stand on slope flattening as a universal principle. He realized that the boulder-clad cliff or Felswand is a common slope element in arid regions, and admitted that such a cliff may undergo parallel retreat, in distinction to the basal slope which flattens (10).

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