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Geodiversity and the natural history of landforms

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For a long time, landforms were studied according to the criteria exposed in the theory of the geographical cycle, at least for geomorphologists claiming a Davisian approach. In this context, particular importance was attached, concerning landforms, to the remains of "peneplains". At this point, it must be remembered that Davis has never been followed unanimously, including the United States, but it was the German geomorphologists who by far developed the strongest criticism of Davisian ideas: scientists such as Albrecht Penck, Siegfried Passarge or Johannes Walther could not be satisfied with views so different of concepts and methods used by German naturalists in geology, geography and geomorphology. This intellectual opposition, however, leads Davis to constantly improve the model of the geographical cycle depending on climatic conditions (arid cycle, glacial cycle…), thick formations of limestones (karstic cycle), or a peculiar geographical position (coastal cycle, coral reef problem).

After 1950, Davisian conceptions were, either abruptly given up (Strahler), or severely criticized (Tricart, Hack, Chorley), or deeply modified (King, Baulig, Klein), in particular to make them compatible with situations where it is not possible to identify in the topography the remains of several geographic cycles. For example, in the case of the Appalachians, Hack's originality is to reason exactly at the opposite to Davis and Johnson. Where the latter would select in the topographic continuum supposed elements of successive cycles, in order to interpret current landscape with the hypothetical lights of a theoretical past, Hack starts by a comprehensive analysis of landforms, patterned reliefs and soils of the present mountain chain, leading to the famous conclusion that the Appalachians are not evolving under decay conditions but are in situation of steady state through dynamic equilibrium. So the question becomes now to understand how far it is relevant and how it is possible for a geomorphologist to travel back in the past, a delicate and speculative succession of operations: as noted by Schumm (1979, 485), "The extrapolation of measured average rates of erosion and deposition to longer periods of time is misleading, in the sense that they do not reveal the natural complexity of landform development or the variability of existing landforms".

Any extrapolation in the past or future implies true actualiste approach verifying only methodological uniformitarianism (i.e. spatial and temporal invariance of natural laws) as well as quantitative models purged of any hint of gradualism and which takes into account variations of timing, frequency and intensity in the action of morphogenetic forcings. In continuation of Hack's work, the concepts of landscape sensitivity developed by Brunsden and Thornes (1979) explain that some landforms are particularly well fitted to the present conditions of endogenetic and exogenetic forcings (characteristic landforms) while others not at all (transient landforms). This highly effective approach within the Holocene and the Pleistocene marks the beginning of a return to the investigation of the past in geomorphology, given that for the Neogene or even older times, the ancient concept of "héritage" (Birot, 1958) seems more relevant than the concepts of transient or characteristic landforms. We propose here as an illustration to describe the sequence of landforms defined in the Southern Massif Central (France). The full sequence is to be observed between the Languedoc Lowlands and the Monts de Lacaune Highlands, while an elision of the lower terms of the sequence towards the Aquitaine Basin allow to highlight a highly significant limit between two modes of landform development at regional level. In short, the natural history of landforms deserve a high status in the Earth sciences: geomorphology not only needs mechanics and chemistry (i.e. the changing ratio of tectonic-driven to climatic-driven processes), but history too (i.e. landform development in space and time).