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PROBLEMS OF GEOMORPHOLOGICAL RESEARCH IN GREECE

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Since the publication of the basic studies by Alfred Philippson, the various aspects of geomorphological research have changed considerably. If we regard the more recent German literature, we may register several scientists who have continued the tradition marked by Alfred Philippson (1950 - 1959), Otto Maull (1921), and Nicolaus Creutzburg (1958, 1961), so above all Hans Poser (1957, 1976) and Jürgen Hagedorn (1969, 1977) focussing on Quaternary geomorphological aspects of the Greek high mountains or Dieter Kelletat (1975, 1979) emphasizing those of the coastal areas of Greece. Furthermore, we must keep in mind Ludwig Hempel's (1982) studies which are relevant for questions of the Holocene landscape evolution in Southern Greece, and the investigations on alluvial fans by Wolfgang Thiem (1981). As these examples illustrate, modern scientists of German-speaking origin seem to concentrate on the study of geologically young associations of forms.

French geomorphologists (Dufaure, J., 1975, Faugeres, L., 1975, Pechoux, P. Y., 1977), on the other hand, have published various outstanding extensive mappings and analyses of forms of the Peloponnese, Epirus, Acarnia, Mount Parnassus, and Crete, just to name a few examples.

Due to the close relationship between geomorphology and geology, morphotectonic questions represent dominant topics treated by more recent Greek authors, especially by members of the Athens working group (Mariolakos, 1976, Sabot, 1976). They emphasize not so much the specific associations of forms, but rather their methodological relevance for geologic-tectonic problems. Apart from these questions, morphometric aspects are frequently dealt with, for instance in studies on drainage patterns in order to draw conclusions on specific lithologic conditions.

With the following considerations I want to attract your attention to some geomorphological problems different from those just mentioned and for which, for instance, "the "Working Group for Geography" in Thessaloniki (Babliake, E. G., 1981, Sotiriadis, L. D., 1975, 1981, Psilovikos, 1986) has done various preliminary studies.

First of all, let us give a thought to the problem of the relatively extensive systems of planation surfaces in Greece, as developed, for example, in the area of the East Thessalian mountain range, on the Cyclades, on the East Aegean islands, or on the Peloponnese. Everywhere in these regions, systems of planation surfaces of the peneplain type prevail. Most certainly they represent relict forms as they are being dissolved by initial and dominant linear erosion. William Morris Davis (1899) still conceived these peneplains as evidence of the stage of old age of landscape evolution. Davis interpreted the gently rolling appearance of these planation surfaces, where exclusively valley-bound drainage systems have not yet been established, as a function of time, namely that due to the long duration of fluvial erosion, the valley bottoms widened to level systems at the expense of the watershed ridges.

I would like to contrast this linear dependance of level formation on time with a spatial-functional aspect. This implies that we must take the climatic conditions into consideration that control not only the biological substances of landscapes, but also the weathering and denudation processes on the Earth's crust. With regard to paleogeography, it should thus be possible to conclude from specific combinations of forms including paleosols to specific climatic environments. In this respect, I think

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that the comparison of the relict elements of forms in Greece with similar ones recently developing in different climatic zones is of considerable importance.

The specific paleoclimatic conditions responsible for the formation of the Greek peneplains are a question not entirely solved yet. As far as we know, we may detect certain similarities to the zones of recent level formation comprising the humid savannas and the dry ones. Whether the climate at the time when the Greek peneplains were shaped might have corresponded to the east side climate of subtropical latitudes (as it is, for instance, in southern China) is a matter still to be investigated. It may be regarded as an established fact, however, that relict peneplains may develop within relatively short periods of time, because not only the function of time, but also the climatic forces of denudation promote their formation. Let us consider the situation on the Cyclades, for instance. There we know for certain, that only 3 to 4 million years were available for the development of a three to four-step Piedmont benchland. You see, peneplains in Greece may be conceived as geologically young phenomena that have nothing to do with old age landscape features.

Apart from peneplains, pediments and glacis are another characteristic association of forms in Greece. Especially in the intramontane basins filled with Neogene, we may distinguish most impressive examples of such pediment-glacis sequences. Yet pediments without glacis occur as well, such as on the peninsula of Mani and in Arcadia. Both types of pediments show various ages of formation, and the paleoecological conditions at the time of their development involve a number of problems. In Greece we have found more evidence for a tropical-seasonally humid origin of both types rather than for the arid morphodynamic system of pediments as often postulated in textbooks. In addition to peneplains, pediments and glacis, we may distinguish a third category of landforms associated with carbonate rocks which generated marginal karst plains and poljes. The large poljes (for instance in Epirus or in Boeotia) were still affected by the Late Neogene planation processes of the tropical era, whereas the small poljes developed only after the formation of the Plio-Pleistocene glacis of the intramontane basins.

There still remain a few questions to be solved concerning the correlation of paleoclimatical findings obtained from morphological studies and paleobiological research results. These problems are frequently of a more methodological kind, so for instance the application of the actualistic approach or difficulties in terminology - just think of the term "subtropical", which everybody defines in a different way. A further example is given by the fact that peripheral-central and hypsometric modifications of one and the same macro-paleoclimate are usually ignored.

Another important aspect arises from viewing the paleoclimatically controlled morphodynamic processes as a paleobiotic disturbance syndrome. So far, paleobiologists have largely neglected the significance of morphodynamic processes when reconstructing paleobiotic environments. The autochthonous and allocthonous location of paleobiotic substances, however, need not necessarily imply a temporal succession. It is possible, for instance, that the allocthonous location is a direct result of specific forces of denudation. Or, to give another example, the factor of sheetflooding, characteristic of paleoclimates similar to the present-day seasonally humid tropics, may exercise a dominant influence on the structures of paleoenvironments, because the upper parts of the pedosphere are kept in constant mobility. In this case, the specific paleoclimate is responsible for the type of denudation. Denudation, on the other hand, directly controls the paleoenvironment (e.g. allocthonous location, discontinuities), whereas climate is only indirectly effective.

A further problem to be considered are the different reaction times of inorganic and biotic partial complexes of paleoenvironments. In contrast to the quick response of paleoforms of life to altered external conditions, morphodynamics require considerably longer reaction times as they become affected only through changes of the pedosphere. On principle, it is therefore possible that the paleobiosphere gets modified within relatively short periods of climatic changes lasting about a few

hundred thousands of years, after which the status quo continues, whereas the relict morphological forms do not reveal any influence at all. The undisturbed development of the peneplains in the hinterlands of the Mediterranean Basin during the Upper Miocene and Lower Pliocene may serve as an example for the ineffectiveness of the salinity crisis.

The discrepancies between the various paleoclimatic research results of paleobiological and climatogenetic geomorphological studies on relict landforms may be partially explained by these differences in reaction times.

In Greece, problems of Neogene geomorphology are contrasted by those of Pleistocene morphodynamics. In comparison with the extensive research carried out in the Alps, we actually know very little about the glacial morphological features of the Greek high mountains. With regard to periglacial phenomena we may distinguish two contrary points of view. On the one hand, some scientists assume that frostdynamic solifluction processes occurred down to the sea-level, on the other hand we find evidence that in the Pleistocene, the present-day eumediterranean low-lying zone of Greece was affected only by convergently periglacial processes without frostdynamic activities.

Finally, some completely new aspects, which still have to be studied in detail, arise from the proof furnished by Ludwig Hempel on the Holocene climatic changes between 5,000 and 3,000 BP. According to Hempel's results, we may postulate a considerable amount of naturally induced soil erosion for that period and that man's socio-economic activities only had a modifying effect on denudation processes.

At the time when our classical regional geographies were written, this fact was not known yet, and the inhabitants of the Mediterranean area were decried as the causers of environmental destruction since the days of the Bronce Age.

The recognition of relief generations might, therefore, be regarded as one of the main tasks of future geomorphological research in Greece. A relief generation (Riedl, H., 1984) may be defined as a sequence or association of forms that reveal the same age of formation, but need not be homogenous with respect to their morphotectonic character.

Considerations like these have formed the motivation for the studies (Riedl, H., 1973, 1974, 1976, 1978, 1979, 1981, 1982, 1984a, 1984b, 1989) carried out together with my colleagues (Stocker, E., Katsikis, A., 1981, Weingartner, H., 1982) for the past 20 years. Beginning with the Upper Cretaceous-Lowest Tertiary and continuing up to the Holocene, we have been able to distinguish nine different relief generations in Greece. It must be noticed that buried associations of forms alternate with exhumed ones in a specific manner.

Finally, let me touch the aspect of morphotectonics, which has had a particular tradition with Greek scientists. I just want to remind you of the studies by Kténas, Psarianòs and Mariolákos 1979). Nevertheless, I think that it is not only neotectonical fault scarps and dislocations of sometimes considerable extent that prevail. We might just as well discover a different model of morphotectonics realized in Greek nature: There exist planation surfaces that cut complicated fold systems without regard to fractures and other lineaments. Extensive, multiple-step Piedmont benchlands with systems of different ages reach across epirogenetic uplifts without fractures or flexures. The increasing amplitudes of uplifting indicate extending phases. In what way this fractureless type of Piedmont benchland may be related to plate tectonic preconditions, remains a task for future investigations.

In my considerations I quite consciously neglected all those questions that are closely connected with the geotectonics of Greece, because I wanted to draw your attention to the usually less considered exogenetic aspects and to some future research perspectives related to exogenetic control systems.

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