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Mountain Studies

Alexey Gunya and Matthias Schmidt

Introduction

The peculiarity of mountains as landscape types, to have in addition to the horizontal extension also a vertical extension, makes them particularly interesting for scientists. Due to different scalar distribution of solar radiation, temperature, and precipitation conditions, a highly differentiated relief with a wide variety of slopes, and complex geology, there is an enormous ecological diversity in a relatively small area. In this respect, mountains offer numerous starting points for scientific questions and are a fascinating object of research.

Outline of the History of Mountain Research

Besides knowledge about mountains provided by ancient scholars from China, Japan, India, Iran, Egypt, Greece, and Rome (Sarmiento et al. 2023a), the scientific exploration of mountains in the Western hemisphere began at the latest with the ascent of Mont Blanc by Horace Bénédict de Saussure in 1787, who carried out geological observations as well as barometric and thermometric measurements (Sunyer 2022). Alexander von Humboldt also conducted extensive research in mountainous regions. During his American expedition (1799–1804), he not only carried out meteorological, geophysical, geological, hydrological, and biological measurements and observations, but also described the local societies and their

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economic activities in detail. Humboldt's observations on hypsometric changes in form, presented in vivid illustrations (e.g., *"Naturgemälde"),* can be regarded as an archetype of scientific mountain studies. In contrast to later, more disciplinary research, Humboldt pursued a holistic approach, showing an interest in geophysics, geology, meteorology, biology, but also in the economy and sociology of mountain populations, creating a montological view of mountainscapes (Wulf 2015).

It was geographers in particular who examined mountains in their entirety and specificity and thus had a central influence on mountain research. In the twentieth century, natural scientific approaches dominated, with a focus on physical and ecological features and processes. Accordingly, the complex interactions between climate, geomorphology, soils, fauna and flora were the focus of Carl Troll's (1972) geo-ecological approach. The systemic-structural direction in the study of mountain natural complexes was developed within the framework of the Soviet school of landscape science (e.g., Sochava 1978). In the 1970s and 1980s, in particular German geographers (Grötzbach and Rinschede 1984; Uhlig and Haffner 1984; Rathjens 1988) were involved in comparative high mountain research and developed corresponding classification systems. They emphasized specific characteristics of utilization systems in mountains, such as the vertical stratification of use levels, the dependence on natural resources, the persistence of traditions, high mobility, specific settlement patterns, and common property regimes. The vertical stratification of socio-economic zones was seen as a prominent feature in the mountain context, analogous to the altitudinal zones of physical geography. Human geographers interpreted mountains as frontier areas to which people had to adapt and as supplementary areas for the more modern lowlands, which offer specific resources (e.g., minerals, wood, dairy products, herbs) and functions (e.g., sites for recreation or hydropower). These explanations of human adaptation to mountain environments demonstrate a rather environmentally deterministic thinking.

Scientific activities and research have been intensified in mountain areas as part of the "Man and Biosphere" program to study ecological, economic, and cultural processes in the European Alps (UNESCO 1974). The project was based on a systems approach, which assumes that human communities are in balance with their environment, and places little emphasis on people and their role as active agents of their environments (Smethurst 2000). Questions of human influence on mountains became the focus of attention, culminating in the discussion of the Himalayan Dilemma (Eckholm 1975). The central thesis, following a neo-Malthusian argument, which sees population growth and resource scarcity as the major problem, is highly simplistic in that it not only treats the mountain peasants as a homogeneous group, but ignores historical, ethnic, and socio-cultural differences relevant to conflict negotiations, as well as power relations, marginalization, and impoverishment. Although the mountain farmers are regarded as actors, their concerns and constraints as well as the influences of external forces are not taken into account. Ives and Messerli (1984) are concerned about the "stability and instability of mountain areas," which is endangered by human influence. Population growth, increased use of susceptible land, overgrazing, and deforestation were seen as the most damaging activities in the Global South, while tourism, recreation, forestry, and the

construction of roads and dams are damaging mountains in industrialized countries (Gerrard 1991).

Most research on mountains since the 1970s (see Price 1981) uses methods from the environmental sciences and shows the hallmarks of the quantitative revolution with the increasing use of scientific data, modeling, and quantification of parameters for machine learning, meta-data mining and artificial intelligence. Mountain areas are widely regarded as closed containers, although the thesis of isolated and remote mountain areas was already questioned by Nigel Allan (1986), who criticized the altitudinal zonation model and proposed instead a model that takes into account accessibility features and changing transport infrastructures. Hewitt (1988:22) even calls "into question the whole idea of mountain regions as a meaningfully separate area of investigation," since changes in mountains depend on developments, initiatives, and penetrations from outside the mountains, which in turn influence the reactions of mountain dwellers. Several authors have therefore emphasized the importance of so-called "highland-lowland interactions" and the integration of mountain regions into the global economy (Ehlers and Kreutzmann 2000).

Mountains after the "Earth Summit"

Mountains received special attention in Chap. 13 of Agenda 21 of the 1992 UN Conference on Environment and Development in Rio de Janeiro. Mountains provide globally important resources such as water, energy, biodiversity, raw materials, timber, agricultural products, and landscapes for recreation and tourism. Their importance, especially for the foreland, and the threat to mountains were emphasized (Stone 1992). Sustainable development has become the new buzzword in almost all publications on mountain development. However, most approaches continued to appear sterile and technocratic.

An imbalance between natural and social science approaches is also demonstrated by the publication "Global Change and Mountain Regions" by Huber et al. (2005), in which only 125 of 650 pages are devoted to the human dimensions (of global change in the mountains) and political and institutional aspects are the focus of only two of 61 chapters. The situation is only marginally different in the highly regarded publication by Price et al. (2013), in which seven chapters take a natural science approach and only four chapters are more likely to be seen as social scientific or integrative. In such publications, humans are seen as a calculable factor or as an element of a system that can be measured, classified, and modeled.

Mountains have been labeled with terms such as limited accessibility, verticality, fragility and marginality, diversity, and human adaptive mechanisms (Messerli and Ives 1997. Although the dynamics between people and their environment have been studied and better understood in many respects (c.f., Funnell and Parish 2001; Parish 2002; Sarmiento 2022; Schickhoff et al. 2022), studies on the cultures of mountain peoples, on political factors, and processes within mountain areas and

between mountains and their surroundings have remained largely underrepresented. The consideration of human actors and their political positions, historical developments, external interventions, and institutional frameworks is a priority issue, which is why Schmidt (2008) proposes to apply a political-ecological approach to mountains. Awareness of the role of man in the transformation of mountain nature led to the need to include him in the object of research, first within the framework of natural-economic systems, and then to complex adaptive and socio-ecological systems (Klein et al. 2019). The current stage of critical rethinking (Sarmiento et al. 2023b) claims to form the prototype of a new super-interdisciplinary mountain science that seeks to radicalize geoscience (Castree 2017), moving to a higher level of place attachment based on the use of local languages and place names (Kong and Sarmiento 2022). In the context of decolonization, the reflection of connections between nature and people shifts towards local actors and cultures.

This brief summary of the history of mountain research clearly shows that it was primarily conducted by white men from the Global North, especially from Europe and North America. The voices of local populations were little heard, their expertise initially ignored, later perhaps partially acknowledged, but only in exceptional cases directly articulated in the dominant scientific language and heard by the international scientific community. Researchers from the Global North still dominate mountain studies today, but at least the scientific community is now much more female and diverse.

This inequality is also reflected in the major *institutions* dealing with mountain areas: *The Mountain Institute* is located in Berne (Switzerland), the *Centre for Mountain Studies* in Perth (United Kingdom), the *Mountain Research Station of the University of Colorado Boulder* (USA), the *Institut de Géographie Alpine* in Grenoble (France), and the *Institute for Interdisciplinary Mountain Research* in Innsbruck (Austria). Only the *International Centre for Integrated Mountain Development* (ICIMOD) with its location in Kathmandu (Nepal) and the *Central Asia's Mountain Research Centre* (MSRC) of the University of Central Asia in Bishkek (Kyrgyzstan) represent important mountain studies hubs in the so-called Global South.

The European dominance is also recognizable in the most important *scientific journals* with a designated focus on mountain areas but indicates a shift in research regions and bias. *La Revue de Géographie Alpine/The Journal of Alpine Research* was founded in 1913 and publishes research predominantly on the Alps and other European mountain ranges. As a result of the Himalayan Dilemma discussion and the discourse of environmental stress in mountain areas, the journal *Mountain Research and Development* was founded in 1981. Although edited in Switzerland, the journal has a bias on mountains of the Global South. The international *Journal of Mountain Science*, founded in 2004, is supervised by the Chinese Academy of Sciences; however, just like most research on mountains, it is published in English. *Pirineos, the Journal of Mountain Ecology*, published since 1945 by the Superior Council of Scientific Research (CSIC) of Spain is available online since 2007 with articles printed in either Spanish, French, or English.

Mountain Studies in the Twenty-First Century

Current mountain studies must face up to the challenges of the twenty-first century, which requires both a critical examination of its own disciplinary history (decolonizing mountain studies), inter- and transdisciplinary cooperation, and multimethodological approaches.

A special feature of mountain research is that concepts and methods from different periods of development have not disappeared; they continue to coexist, forming a kind of palimpsest (Sarmiento 2022). In this palimpsest, two directions can be distinguished: The first and still dominant direction is the positivist thinking that mountain processes are *objective* and measurable (Price 2015). It follows a *deductive* approach, when well-developed concepts and theories are distributed over large areas. The second direction tries to understand the diverse and individual experiences and practices in the mountains, including subjective awareness and assessments on the ground. It is close to what is called a *constructivist approach* in social sciences (Flint 2016) and uses mainly qualitative methods. Living experience and an attempt to reflect reality through the eyes of local residents, including recognition of oral traditions, myths, art, etc., help to better understand ways of adapting to current challenges (as opposed to strategies and concepts such as sustainable development imposed from above).

A new way of looking at mountains and mountain research is currently emerging. It is influenced by postmodernism and characterizes the critical reflection of positivist, constructivist, and other ideas about mountains and mountainousness (Sarmiento 2020, 2022). Tracing the trends in the formation of mountain research (Price et al. 2013, Sarmiento et al. 2023b), several directions can be identified, among which further interdisciplinary integration and decolonization of knowledge about mountains clearly stands out. All three of these trends are interconnected, each influencing the other (Fig. 1).

Interdisciplinary research underlies the development of mountain studies, reflecting the close connections of natural and social processes in mountain scape. Currently, interdisciplinarity also serves to balance the social and natural sciences components of mountain socio-ecological systems. This is associated not only with the inclusion of social scientific methods and the study of population, culture, ethics, etc., but also with the study of the interaction of nature and society as a qualitatively special process that arises at the intersection of sociocultural, economic, natural, political, and other phenomena, with an analysis of the evolution of this process in time and space and with clarification of the mechanism of occurrence and the reason for the existence of certain correlations within the framework of "socio-ecological systems." Further, it involves value relations in the analysis (Leiserowitz et al. 2006), which have not an economic, but a socio-cultural assessment (image, family, traditions, etc.), traditional ecological knowledge has gained great importance.

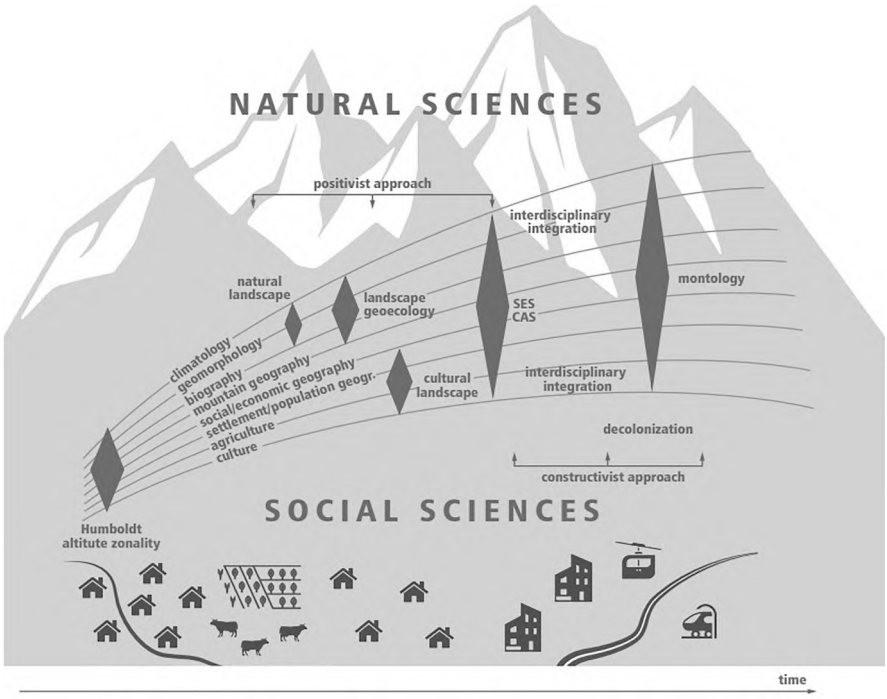


Fig. 1 The scope of mountain studies integrating social and natural sciences with positivistic and constructivistic intersections to reach convergence through time towards montology. (*Source:* authors' elaboration and design)

Decolonizing Mountain Studies

The formation and development of mountain studies was dominated by Western scientists and mainly by natural scientific directions. Mountain territories were assessed as unique environments and resource depot for mainly dominant societies in the lowlands—the fact that mountains are unique resources for local peoples was long ignored. In this context, numerous development projects were carried out, based on concepts and models developed in the Global North. However, in recent decades, within the framework of mountain studies, the achievements of national sciences have begun to intersperse into this history. The fall of the bipolar world and the tendency to rethink science within the framework of a decolonial approach (since the early 1990s) provides a chance to involve local cultures and national-regional sciences in the development of consilient mountain studies.

Following Jack Ives' (2005) initial advocacy of mountain studies, Fausto Sarmiento (2020) defines *montology* as a holistic, integrative, and transdisciplinary science of mountains, including physical, social, theoretical, and empirical disciplines, as well as the humanities and arts related to mountain landscapes.

Conclusion

In the context of current trends in the critical understanding of knowledge about mountains, methods, and approaches, mountain studies are enriched by local ideas about mountain-human systems, national approaches, and methods that challenge toponymy, and value systems of research. However, it should be emphasized that the achievements of previous generations of scientists who explored mountains formed an indisputable foundation for current mountain studies.

The processes of interdisciplinary integration and decolonization are significantly transforming mountain studies. We are facing a rethinking of basic concepts that reflect our understanding of mountains. There is a shift towards increasing the role of place and local structures, involving non-scientific knowledge and experience. All this "montological turn" significantly overestimates the scope of transfer of theoretical and practical knowledge about mountain studies, primarily in the field of value systems about development, standard of living, and resilient mountain socioecological systems.

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