1. Packing transdisciplinary critical geography amidst sustainability of mountainscapes

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INTRODUCTION

This Elgar Companion book seeks to frame sustainability as an exemplar of transdisciplinary science informing critical geography while improving future scenarios for the world communities that are debating prospective fates between the rich North and the poor South, the modern urban and the backwards rural, and everything in between. Through the following pages the reader will find unorthodox views about sustainable development and sustainability science, challenging dialectics and incorporating alternative propositions for defining sustainability as the maintenance, improvement or regeneration of living conditions in the planet for both human and more-than-human constituents (Gibbes et al. 2018). The use of mountain studies exemplifies the new narrative of integrative, holistic approaches for geoliteracy about mountainscapes and will serve to motivate further research in the field of transdisciplinary mountain science.

Earlier calls for transdisciplinary approaches to understanding landscapes were made by Naveh and Liebermann (1984) who viewed landscape ecology as a transdisciplinary, ecosystem-education approach, based on general system theory, cybernetics and ecosystemology as a branch of the total human ecosystem science. Yet, despite the more comprehensive planning angle exhibited in Europe contrasting to the more geospatial-based landscape ecology of North America (Forman & Godron 1984), the notion of transdisciplinary science still retained the character of positivistic Western Ecological Knowledge (WEK). It was not until 1992 with the development geographies of the Global South approach to Political Ecology that transdisciplinarity became a paradigm to understanding nature and culture from a Latin American perspective (Naveh et al. 2002) and from the critical move to activate interdisciplinary studies and multidisciplinary studies favoring the integration of alternative epistemologies (Lang et al. 2012).

“Mountains” as an exemplar of the challenge of packing sustainability from frameworks of development geographies, area studies and biogeography of socio-ecological systems (SES) add to a decadal effort from a plethora of mountain scholars of inserting a recognizable goal of a new transdisciplinary field, *montology* (Mahat and Boom 2008). The reason for this contemporary framing of sustainability is the impetus that new paradigms to understand human–environmental relations from several perspectives at the same time (Dunlap and Van Liere 1978; Dunlap et al. 2000; Boillat, Chapter 19, this volume) bring to post-phenomenological landscape studies in the geographies’ frontier of decolonial theories and hybrid narratives. Recently, the search for integrative approaches to the understanding of Complex Adaptive Systems (CASs) and the long-term stewardship of mountain ecosystems as SESs has led to a renewed focus in “montology” (Haslett 1998). Thus, the evolving theoretical and practical applications of critical geography

require a fresh effort, echoing from its initial postulation in 1977 to develop the discipline of mountain studies from a new angle towards sustainability (Allan n.d.). The integrative bridging of science and humanities via transdisciplinary approaches is now perceived as necessary to understand even the most complex of issues and grandest challenges of the present day (Baer & Singer 2014). This chapter peruses an onomastic context to reflect lexicographic domains—not easily translated into English—to help comprehend unorthodox geographic traditions of sense of place. In so doing, this chapter shows how the transdisciplinary approach of montology challenges geographic realism and informs the complete SES dimension of sustainable mountainscapes.

HISTORICITY

Unlike past disciplinary trends in geography's subfields, and due to increasingly available sources of information, funding and academic training at present, most scholars interested in mountain issues find themselves now navigating a labyrinthine circuitry of environmental cognition, mostly guided by reductionist premises and positivistic methodologies for field research, theoretical dogmas and applied technologies for mountain terrains (Price 2015). These scholars have found themselves locked in binary silos that brand them as either "physical geographers" or "human geographers." However, with the realization by ecologists and social scientists alike that geography is the environmental science *par excellence* (Wulf 2015a), more professional geographers have, indeed, internalized notions that navigating the CAS of mountains must be done along the spectrum of the two disciplinary poles, allowing for integrative, comprehensive and critical views of sustainability (Wilcock and Brierley 2012) of the space/time compression of the present (Massey 1999) in contrast with the static, descriptive views of mountain geography of the past (Wulf 2015b). Sustainability science and landscape ecology theorists called this "cross-disciplinarity" (Wu 2006).

Being more than inter- or multidisciplinary (Annan-Diab and Molinari 2017), modern assessments of SESs require transdisciplinarity when considering research priorities of sustainability (Wu & Hobbs 2002); this approach is something that Jack D. Ives has long suggested as "montology" to advocate for mountain cognition (Mainali and Sicroff 2016). According to Mahat and Boom (2008), conceptualizing disciplinary fragmentation in mountain research and development indicated that:

The term montology has been used in oral communication and in print many times over the past twenty-five years. According to Jack Ives, the term was first informally introduced by Frank Davidson in 1974 in Munich, Germany, at the same conference in which the journal *Mountain Research and Development* (MRD) and a future International Centre for Integrated Mountain Development (ICIMOD) were envisioned (Jack Ives in personal communication with Robert E. Rhoades). The Munich conference proceedings reported: "just as oceanography has spawned a number of major and minor institutions concerned with the protection and development of ocean resources, so mountainology, once its importance and implications are realized, will lead to a proliferation of institutional responses" (GTZ, 1974: 186). In subsequent discussion between Frank Davidson and Jack Ives, the term mountainology was dropped in favor of montology.

Notwithstanding the lexicographic difficulty with the call for montology in 1974, the "Club of Munich" persisted in the effort, which became stronger with the addition of

American scholars such as Paul Baker, Ben Orlove, Steve Brush and Colin Rosser, and the consolidation of the International Mountain Society (IMS) and its journal *MRD* (Ives 2005). It is because of this momentum that in the Cambridge Mountain Conference of 1977, the myriad sources of information on mountains evidenced the need for transdisciplinary approaches. The conference proceedings, compiled in 1982 by Susanne Fairclough, records:

At the Cambridge Mountain Conference in 1977, participants discussed the creation of a discipline for the study of mountains, as has been accorded to oceans, and gave it the name of montology, to denote an active, protective emphasis (Allan n.d.).

The term *montology* was included in the unabridged Oxford English Dictionary in 2002, generating debate between those that saw it as jargon or unnecessary, and those that claimed disciplinary identity with the exclusive moniker. Because of the ambivalence towards montology in the mountain scientific community, a call to move “mountains” up in the global environmental agenda was formalized (Bandyopadhyay and Perveen 2004), which prompted Rhoades (2007) to state the need for more discussion on whether mountain scholars and practitioners needed a field of their own. The application of transdisciplinary science started with Piaget (1972) and became standard in modern academia (Hadorn et al. 2008), with the popularity of this approach reflected mainly in three substantive gains: (a) holistic health science and medicinal issues (Klein 2008); (b) the bridging of disciplines (Veteto 2009); and (c) the need for integration (Nanshan 1998). Not only the recognition of mountainscapes as CASSs, but also the realization that those mountainscapes were actually SESs propelled scholarship towards seeking explanatory research for emergent properties of mountain sustainability (Polk 2014), including their diversity, memory, openness, synergy, uncertainty and resilience, particularly amidst global environmental transformation, including climate change research (Xishi and Yuanchang 1996). These efforts towards mountain studies have coalesced now in the Feldafing Accord of 2010, prompting universities and governments to create research institutions for mountain research among countries of Asia and the European Alps. These trends have repercussions in what Sarmiento (in press) calls “the Montology Manifesto,” calling for action to transgress academic silos, affording mountain research not only to the established research centers, but welcoming unorthodox institutions, foundations, non-governmental organizations (NGOs) and community driven mountain work both in the sciences and the arts.

TRANSGRESSIVITY

A decade later, the cross-disciplinary imperative became a *tour-de-force*, as the need to better define Mountain Geography was overt. Thus, several attempts to develop a comprehensive textbook for mountains, whether in alpine geography, ecology, geomorphology or forestry, existed. Recent productions of integrative approaches given by Price et al. (2013) incentivize the intersection of the physical environment with the human dimensions (Sarmiento 2015). Highly respected mountain scholars have also incorporated Ives’s montological vision, including Axel Borsdorf, Christoph Stadel, Yuri Badenkov, Robert Rhoades and Larry Hamilton (Ives et al. 2016). Here, I use the

Figure 1.1 *Interacting transgressivity among the realms of critical thinking*

geo-/eco-driven onomastics of Mountain Specificities (*sensu* Jodha 2003) to describe the disciplinary transgression and referentiality (Westphal 2011; Tally and Battista 2016) by using foreign words that lack direct English translation, in a review of critical physical geography (see Figure 1.1) of the three dimensions needed to truly contest the theme by rethinking Mountain cognition (*sensu* Tadaki 2017) by being:

1. **Critical *in*** or geoliterate, in the physical biogeographic mountain setting, encompassing descriptive, meristic variables;
2. **Critical *of*** or ecoliterate, in the socio-ecological mountain production system, including analytical, non-meristic variables; and
3. **Critical *through*** or sopholiterate, in the mental mountain imaginaries, encircling mythological, ethical and morality variables.

This new epistemology seeks to radicalize geoscience (*sensu* Castree 2017) with linguistic artifacts conveying ideas without a readily translatable English word, so that the reader is forced to use whole sentences (instead of single terms, as a way to integrate disparate concepts from several subjects) to execute transgression towards mountain cognition (Prieto 2011) to sustainability. Examples of those untranslatable terms include Arabic (*barzakh*), Portuguese (*saudade*), Sanskrit (*kharma*), Spanish (*arraigo*), French (*terroir*), and German (*Gemütlichkeit*) languages. I invite anglophone readers to try and think about unfamiliar terms, to realize the move to geocritical acceptance of *montology* as a foreign word, and to get on track with its customary use by mainstream researchers. Indeed, as geocriticism becomes the tool of choice for understanding environmental literature (Prieto 2016), the accent placed on fuzzy boundaries of science and humanities

become notable, making geoliteracy more relevant than ecoliteracy when confronting research questions dealing with the hybrids of science and humanities, because ecoliterate points to the “nature only” shrewdness of the biological landscape, while geoliterate points to “nature/culture linkages” sagacity of the biocultural landscape.

In-depth understanding of “Mountain Research” reflects a tendency to shift from the archaic term *orology* (Greek etymology for mountain and knowledge) to the postmodern term *montology*, (mixed Latin and Greek etymology for mountain discourse) posing a trend to incorporate more-than-human elements and spiritual dimensions in understanding those mountainscapes as SESs. Even specialized bibliographies on mountain geography (e.g., Resler & Sarmiento 2016) are inclusive of this new trend of multifunctional approaches for complex adaptive systems (CASs) with holistic premises and postmodern and poststructuralist methodologies for mountain cognition (Sarmiento et al. 2017). Earlier pundits of the term criticized this etymological mixing, without realizing that many scientific disciplines mix Latin and Greek roots, including mineralogy, inscriptology, phraseology and oceanology (Yuanchang 1986).

New integrative research includes not only multidisciplinary (*sensu lato*) or interdisciplinary (*sensu lato*), but transdisciplinary teams (*sensu stricto*) that allow a crosscutting of collectives of researchers and practitioners to understand farmscape transformation for agrobiodiversity (Zimmerer et al. 2017) or the risk of glacier retreat and climate change adaptation for resiliency and risk assessment (Carey 2010). As of late, funding agencies have prioritized transdisciplinary teams for successful proposals. An example is the creation of groups that take such an approach in American universities with NSF funding: TARN (Transdisciplinary Andean Research Network) funded by NSF as a Collaborative Research Network (Polk et al. 2017) or the SENTINELS group for mountain observatories (<https://mountainsentinels.org/>), MtnSEON (Mountain Social Ecological Observatory Network (<https://webpages.uidaho.edu/mtnseon/>) and the NMC (Neotropical Montology Collaboratory (<http://research.franklin.uga.edu/Montology/>)). Another international example is the project VULPES (Vulnerability of Populations Under Extreme Scenarios) funded by the *Belmont Forum* (<https://www.belmontforum.org>) for global research on mountains and climate change applications, dealing with microrefugia conservation research into mountain forests’ paleodynamics and current ecological trends in several selected sites around the world (<https://vulpesproject.wixsite.com/vulpes>) (Cheddadi et al. 2017). Further indication of this vogue in favor of montology is the policy implemented by the German International Cooperation for Development (GTZ) to only fund development projects if they observe transdisciplinary tenets. Academically, the effort is invigorated by the United Nations University Institute of Advanced Studies in Sustainability (UNU-IAS) running, from UNU headquarters in Japan, a successful International Program of the Satoyama Initiative (IPSI) of productive landscapes and seascapes (<http://satoyama-initiative.org/partnership/>). Another important contribution comes from sustainability science researchers who have identified the transdisciplinary basis of montology (Lang et al. 2012). In the City of Science, near Tokyo, a United Nations Educational, Scientific and Cultural Organization (UNESCO) chair on Nature–Culture Linkages keeps many scholars at Tsukuba University busy researching biocultural heritage (<http://nc.heritage.tsukuba.ac.jp/UNESCO-Chair/>) that contributes to training students in a Master’s program on Mountains. A key move in favor of montology came from MRD, the journal *Mountain Research and Development*, which

adopted a guide to incorporating articles dealing with mountain knowledge generation, application and sharing, with clear reference for inclusion of Traditional Ecological Knowledge (TEK), soft and hard science, to understand the Global North–Global South dynamics of mountain sustainable development. Coincidentally, MRD was founded and edited by Jack D. Ives and published by the IMS until 2000, when the new open journal became available online edited by Hans Hurni at the Institute of Geography of the University of Bern. At present, Thomas Breu (U Bern) and David Molden (ICIMOD) are editors-in-chief, working with associated editors Anne Zimmermann, Susanne Wyman von Dach and Sarah-Lan Mathez-Stiefel, at the Center for Development and Environment at the University of Bern. By that time, AAAR, the *Journal of Arctic, Antarctic, and Alpine Research* was also produced to publish work done at the polar and mountain regions, from an interdisciplinary perspective, produced by INSTAAR at the University of Colorado, Boulder, in the United States of America. Renewed and more fertile publication of mountain research is now presented by the Elsevier/Chinese Academy of Science collaboration in producing JMS, the *Journal of Mountain Science*, with a cadre of illustrious mountain scientists acting as part of its international editorial board, coordinated by Professor Dunlian Qiu of the Institute of Mountain Hazards and Environment in Chengdu, China. Of note is the improved production of *Pirineos*, the oldest published outlet, as the *Journal of Mountain Ecology*, published by the National Council of Science and Technology of Spain, under the editorial oversight of the Pirenaic Institute of Ecology in Jaca, where editors Teodoro Lasanta-Martinez and María Estela Nadal-Romero imprinted an effective outreach for online publishing, particularly emphasizing Alpine and Ibero-American authorship. Similarly, the continuation of editorial leadership of JAR on mountain research with the highly regarded *Revue de Géographie Alpine/Journal of Alpine Research* produced by the Institute of Alpine Research and other research centers of the University of Grenoble, France.

MOUNTAINS, TRANSDISCIPLINARY SUBJECTS

With the advent of critical social theory and postmodernism, scientific disciplines that followed strict frameworks of quantitative descriptive phenomena of dialectics in the hypothesis-testing procedures have found the need to incorporate qualitative, analytic phenomena of trialectics that require a different mindset, and concomitant different tools and protocols, such as onomastics and term causation, political ecology explanatory tropes and critical biocultural heritage paradigms (Sarmiento 2016a). Thus, in order to understand mountain theory from either side of the scientific divide, whether following Cartesian determinism or Spinozan relativism, the need for a transdisciplinary field for mountain studies is evident for sustainability applications (Painter 2008; Hansson 2012). Following Gregory (1994), this “cartographic anxiety” created by linkages of nature/culture defiant against truism urges the epistemology of geoliteracy (*critical- in*), ecoliteracy (*critical- of*) and sopholiteracy (*critical- through*). Thus, montology becomes a *tour-de-force* in current thinking and practical applications of mountain research, particularly in the Global South, where the majority of humanity practices non-Western thought and speaks languages other than English. Translation of whole ideas into a single word will help to cleave geographic referents of mountains.

Figure 1.2 The Sarmiento trilemma for Andean identity

The Arabic term *al-barzakh* describes a condition for the Islamic world, what Catholics interpret as “purgatory” in Western thinking. However, it goes much further in describing the fuzzy line that separates two adjacent fields that are often hard to separate. For instance, the line that separates life from death, light from darkness, or the line that separates the present from the past, or even the separation of the seen and the imagined, some even suggest that separates what constitutes the realm of humans and of gods. This is precisely what montology does in helping to understand the trifecta of mountain ecosystems, by helping to form a complete picture of the mountainscape. Using the example of the Andes, for instance, mountains can be (de)ducted from what it seems, and can be touched and measured (or Andeanity). They can be (in)ducted from what it appears and can be conceived and planned (or Andeaness). Also, they can be (sub)ducted from what it means and can be revealed and imagined (or Andeanitude). The Sarmiento trilemma has now been applied to explain Andean identity and the forces that move effective mountain conservation (Sarmiento 2016b) based on the reciprocity concept of the Andean lifescape (or *Ayni*). The Sarmiento trilemma for Andean identity can be applied to find the essence of place in other mountain systems, by incorporating the so-called deep ecology consideration of landscape dynamics; hence, you may think of Alpeanness, Appalachianity, or Himalitude when you are searching for the hidden mental framework of the Alps, the physical spatialities of the Appalachians or the sacred and spiritual markers of the Himalayas (see Figure 1.2).

GEOCRITICAL MONTOLGY LONGED FOR

Despite having mountains present in the scenery of major urban centers, the meaning of mountain livelihood is diminished due to municipal facilities and infrastructure that

allow for easy connectivity, short travel time, flat terrain or central locations for city businesses or harbors to export to the global society, mostly associated with the lowlands and deltas (Messerli and Ives 1999). In the past, however, mountain civilizations developed their core areas in isolated, often forgotten valleys, where they remained in the backwardness of the edge, the marginal space where they evolved in unique groups and hegemonic empires. The endemism generated by this geographical isolation produced a subspeciation of groups with different cultures, languages, creeds and available resource uses in the creation of mountain myths (Sarmiento 1987; Lewis and Wigen 1997; Zimmerer et al. 2017).

It is here that the Portuguese term *saudade* comes into place, as something that is longed for without proper realization. Most citizens, including the suburbanites and exurbanites of amenity migration areas worldwide, have shown a trend to incorporate the “mountain specificity” needed to survive in the faraway port cities or megalopolises. This longing for the mountain is evident in the manifestation of second-home development or summer home retreats of the expatriates around the world, particularly in the tropical mountains (Moss 2006). The metageography of mountains as part of the identity of “the Self” makes a mountaineer easily identifiable as “the Other.” As the old Irish saying goes: “You can take the girl out of the mountains, but you can never take the mountains out of the girl”; montology allows putting personalized perspectives in the deeply ingrained notion of mountain lifescapes, often politicized and appropriated by contested political ecologies (Ives and Messerli 1989; Debarbieux 2008; and Chapter 3, this volume). In the current globalization race, mountains provide the much needed brake not only to the monotonous flat topography, but enhance landscape quality by providing strategic landscape services, including fresh water, fresh air, ample vistas, resource potential, wildlife refuge, spiritual fulfillment, theophanies and epiphanies, sanctuaries for ancient practices, national pride, historical memory, tourism and recreation, and more intangibles worth protecting as biocultural heritage for the sustainable future (Termorshuizen and Opdam 2009). Therefore, it is in the appreciation of many literary texts and its diffusion through the world’s cultures that montology gets a grip on this integrative effort of geoliteracy (Tally and Battista 2016).

TRANSGRESSIVITY OF MOUNTAIN LORE

The cross-disciplinarity of the sciences and the humanities has flourished recently with the inclusion of scholarly trends to fuse geopoetics, history, religion and other non-science fields as proxies to understand the reality of modern landscapes towards sustainability. Going beyond the confines of the discipline has helped to transgress fields. This recognition is now fueling the training of future scientists as part of STEAM education (science, technology, engineering, arts and medicine) to complete the biased STEM education (science, technology, engineering and mathematics). Hybrid teams are becoming popular across North American campuses, just as collaborative multiversities are now replacing the individualistic universities in the Global South.

With the first book on geocriticism, which appeared in French in 2007, and its English translation (Westphal 2011), the term transgressivity took hold in many social science writings on the need to break down borders, debunk stereotypes and open frontiers

to mesh the sciences and the humanities, even the physical sciences with the social sciences themselves. On the other hand, the transdisciplinary spatial turn is highlighted for the complex urban–rural edges (Soja 1996) and particularly in the integration of multimethods research to inform the challenge of framing shifting mosaics of mountain environments (Zimmerer 1994). However, in order to effectively integrate knowledge, the sequence of events has to exhibit an organized order or self-organizing trend, typical of the so-called Gestalt systems (Naveh et al. 2002). In Gestaltism, there are different factors that have to work together to create order out of chaos, among them: *Emergence* of the whole before the parts; *Reification* of objects with imaginary to fill the gaps; *Multi-stability* by having alternative pathways seeking to avoid uncertainty; and *Invariance* by locking patterns to fast recognition. Montology allows the integration of scientific methods and traditional wisdom to follow the Gestalt principles of spatial arrangement (*à la* Bradley 2014), including the laws of simplicity; of closure, of symmetry oriented to a central place; of figure/ground contrasting elements; of uniformity and connectedness; of common regions, proximity, continuation; of synchrony or common fate, parallelism, similarity; of focal points or locus; and of past experiences towards landscape memory.

Going back to ancestral practices of the Hindu river civilizations, and followed by those of Hinduism and Buddhism affiliation, the cumulative actions of the Self propel the individual towards higher and more complex levels of integration. The *Kharmic* sense of spiritual account towards improvement of soul and body reinforces the needs of the new transdisciplinary science of montology to achieve higher organization and complexity to truly understand sustainable mountainscapes (Sarmiento and Hitchner 2017). An important account of a lifetime effort is given in Ives (2013).

THE REFERENTIALITY OF MOUNTAINOUS ENVIRONMENTS

In the recognition that mountains, by definition, are heterotopic spaces, it follows that anthropogenic landscapes are what we could consider literary palimpsests, often with bioengineered modification by ancient practices that have been sustained by ritual, force or conviction, that prompt us to read our version of the landscape from a paradigmatic narrative. Debarbieux and Rudaz (2015) have pointed to the realization that historicity and political maneuvers have created the idea that we have about mountains, which becomes clear in the confusion of biologists and ecologists when tabulating diversity of neotropical forests that “look” pristine (realized mountainscape), but in reality are hidden SESs and CADs (fundamental mountainscape). These interventions have since millennia constructed anthromes that mountain folk deeply respect and care for (Scheiber and Zedeño 2015). An example from the Andes brings the Spanish term *arraigo* as reference for the love of the land, not only in the territoriality of their construction, but also in the imaginary and representation of ancestry, identity, even nationality. As Borsdorf and Stadel (2016) show in their Andean portrait, the people of the highlands exhibit a highlighted trait of deep *arraigo*. However, the term is more than just rootedness of a person in the area of residence; they are intrinsically linked to the essence of land in space and time. This linkage requires recognition of the social belonging to a place made by intimate relationships with the various elements of the mountainscape. In the *Kichwa*

language or *runashimi*, the word *pachamama* describes not only the land and its products, but also the tenderness of rearing as part of the communal effort, where reciprocity or *ayni* is manifested as the engine of social cohesion of different mountain groups or *ayllu*, and gratitude is acknowledged with payments and offerings or “*pagamentos*” to the land linked in space, with the three commandments for *Inka* wellbeing or *sumak kawsay*, when they are balanced within the trilemma: Do not steal (*ama sua*), do not lie (*ama llulla*) and do not be lazy (*ama killa*) (see Figure 1.2).

They are also intimately linked with the landscape in time, as they train the young in the labor of the land, but also respect the old by providing them a hierarchical place of power with elders often running decision-making in small citadels or *Llakta*. The links in time go back several generations, as it is common for them to bury the dead underneath the floors inside their houses, mimicking the ancestral practice of mummifying the dead. Having this intimate relationship with the land makes “*arraigo*” one of their most cherished values (Sarmiento 2012). Conversely, one of the worst punishments in the Andes is to take the person away from his/her homeland. Extirpated prisoners of war or *mitima* were often forced to colonize faraway lands during the *Inka* territorial expansion. Even at present, Andean communities’ first and foremost political platform is land ownership, communal territories titling, and water rights associated with their cherished homeland or *manta*.

HUMAN IMPACTS ON MOUNTAIN SERVICES

Montology is now proposed as the transdisciplinary venue to understand mountain science, as it was first observed by the father of ecology in the 1800s. Humboldt was inspired in the realization of using pragmatism and positivist research within romanticism and qualitative idealization of the territory in mountain areas to recreate natural history. Such a distinctive approach, already championed by Humboldtian views of landscape character and the human impact of the Tropical Mountains after his visit to *Chimburasu* in 1802 (Wulf 2015b), has occupied the scholarly agency of many geographers, ecologists, anthropologists and other scientists in developing geoecology (e.g., Troll 1968). The ensuing ecological geographies of mountains were highly influenced by island biogeography theories of isolation, colonization and extinction. Later, the geographical ecologies of mountains were also cautiously developed as apolitical spaces with interest only to natural sciences, i.e., geology, flora and fauna (Ives 1980) until the realization of the political agency of conflictive power struggles was made evident not only for mining and agroindustry in the Third World countries (Zimmerer 1994) and the generation of their endogenous perspectives (Sarmiento 2000), but also for the survival of anarchists and their way of non-conformism in “*Zomia*” (Scott 2009).

Montology is claimed to become the venue for inclusion of alternative environmental cognition of mountains, away from the current emphasis on ecosystem services and biodiversity. With either indigenous or TEK that incorporates a third dimension, mountains are rooted also in the emotional geographies of biocultural heritage and the trope of sustainable development (Zhong 2000; Bernstein 2015). Furthermore, the Humboldtian paradigm for horizontally segmented zones on the slopes has been added to with the new montological approach of vertical integration, with important lowland–highland dynamics that encompass not only the biota or the gea, but also the human driver of landscape

ALEXANDER VON HUMBOLDT–23 JUNE 1802

IN MEMORY OF HIS CONTRIBUTIONS TO MOUNTAIN GEOECOLOGY

The Andean Mountains, especially Chimborazo, stirred the imagination and scientific labor of this great man. In addition to his many other contributions, it was in this tropandean landscape, beneath the eternal snows of our majestic volcano, where he laid the foundations of “mountain geoeology,” or “montology,” that continues to mold world society. The Rio de Janeiro Earth Summit of 1992 ensured international recognition of the importance of our mountains, in part from United Nations University research, and created an awareness that is finally transcending into action. This advance culminated in November 1998, when the General Assembly of the United Nations declared AD 2002 as the International Year of the Mountains

**“FOR A BETTER BALANCE BETWEEN MOUNTAIN ENVIRONMENT,
DEVELOPMENT OF RESOURCES, AND THE WELL-BEING OF MOUNTAIN PEOPLES”**

*Chimborazo, the birthplace of Mountain Geoeology
December 15, 1998*

Indigenous Committees of Chimborazo

*Jack D. Ives (IMS/UNU) International Mountain Society
Fausto O. Sarmiento (AMA) Andean Mountains Association
Lawrence S. Hamilton (WCPA-IUCN) World Conservation
Union, Commission on Protected Areas: Mountains*

Bruno Messerli (IGU) International Geographical Union

*Juan Hidalgo (CEPEIGE) Pan American Center for
Geographical Studies and Research*

Patricio Hermida (INEFAN) Chimborazo Reserve Manager

Source: Photo by the author. Taken on-site at the installation of the tri-lingual plaque in 2003. A script from the English section is included above. Pictured are park rangers, the superintendent of the *Chimborazo* faunal reserve and workers from the signage company.

Figure 1.3 The Chimborazo cairn honoring Humboldt and montology

change (Sarmiento 2002). Humboldt is immortalized with a bronze plaque that lies on a cairn at Chimborazo’s snowline (see Figure 1.3), including the words geoeology and montology recognized in *Kichwa* for the Andean world, in “*Español*” for Latin America, and in English for the Global North (Sarmiento 1999).

MOUNTAINS IN A CHANGING STATE OF MIND

The transition to sustainability of mountains from geoecology and landscape ecology gets fuzzy because of the inclusion of non-linear pathways of organization of the Gestalt system, as the CASs of mountains is affected by farmscape transformation. As Lima (2013) stated, it is imperative for us to grasp a new metaphor to understand the world: instead of the arborescent description of *dendritic* representations, we need to assume a new network analysis of *rhyzomic* representations of science, allowing horizontal symbiotic collaborations and bottom-up approaches instead of a rigid verticality of hierarchies and step-wise procedures of top-down practices.

The French term that describes the effects of unifying multisensorial inputs to create an emotional and fulfilling reality, *terroir*, comes to mind. When tasting the first sip of red wine, after the “*catador*” expertly pours the rested wine into the glass, observes it descending the glass walls and bubbling on the expanded surface of the goblet, sniffs the aroma and wets the tip of the tongue before splashing the internal membranes of the mouth, the rush of sensations makes it possible to discern, from memory and imagination, all things that were dear and cherished from the place of origin. *Terroir*, thus, is not only this flavor of fruit or that flower aroma that have integrated the fermented drink, but even the soil, the temperature, the sound of the rivulets, or the wind in the slopes of the vineyard, the youthful voices of friends, the smoke of the cabin nearby, the eyes of the loved one, or even the ambiance of the cozy fireplace or the family diners at the table, all in a swallowing of sensed memory landscape. Montology allows, like *terroir*, the possibility of integrating the tangible and intangible heritage of mountains into a Gestalt system of cognition that is organized with non-linearity, decentralization, interconnectedness, interdependence, multiplicity, and cartographic anxiety. This essence of place given by montological practice allows for sacred geographies to participate in the decision-making of the conservation of mountain systems towards sustainability (Sarmiento 2016a) with brand new lenses (Taylor 2010).

THE ROAD AHEAD: LOOKING FOR PARADISE?

The National Geographic Society (NGS) in the United States has identified “GeoLiteracy” as our most important educational target for instruction to obtain geographic literate youth (Edelson 2011), to which the International Geographical Union (IGU) aptly welcomed the Three-I’s approach into the “Home of Geography,” the putative headquarters of the geographical academy worldwide. I argue that montology must be incorporated as the *de facto* trend to provide geoliteracy about the mountains of the world. By using the transdisciplinary science of montology, we are inclusive of the whole content that affects mountain cognition (Avriel-Avni & Dick 2019). By using montology, we are not only using the Three-I’s approach (Interdependence, Interconnectedness, and Implications) in our study of mountains, but, also, we are facilitating the inclusion of what in German is called *Gemütlichkeit*, a welcoming feeling of hominess, peace, and prosperity that you perceive in the place you love. It is neither the physical appearance of the house environment (*Umwelt*) of the mountain space, nor the imagined sensorial agreement of the home environment (*Lebenswelt*) of the mountain place, but it evokes the actual social construct

of the shared built environment (*Mitwelt*) of the mountainscape or SES (Westphal 2011). The fact that montology eases the categorization of positivistic science, allowing the spatiotemporal identities—or *tempusculus*—in the transgression of disciplinary fields (*sensu* Tadaki 2017), should be recognized, as well as the new referentiality of TEK coupled with WEK to understand dynamic CASs. It makes sense having transgressed referents as the only pathway to comprehend holistic mountain landscapes to juggle myths of the “axial age” or the “dark green religion” as drivers of sustainable future (Provan 2013). As the age-old quest for finding paradise requires—which in many cultures has often been associated with somewhere up there in the mountains (c.f. *Shangri La*, *Meru*, *Xanadu*, *Satoyama*, *Hallelujah*, *Sumak waka urcu*, *Zomia*, *Apu*, *Tepuy*, etc.)—this utopian space/place/landscape/inscape of the mountain ontological challenge is herein made manifest with the use of montology to frame sustainability.

CONCLUSION

Framing montology as an exemplar of transdisciplinary science informs critical geography of mountains towards sustainable futures. The geo-/eco-driven onomastics translates conceptual frames that illustrate the need for transdisciplinary science to guide our current understanding of mountains. The different examples of foreign words make evident the competency of montology as a transgression of disciplinary fields and the referentiality of a new understanding of the mountainscape. Using foreign terms without direct English translation obviates the about-face of reductionistic mountain cognition that separates pieces of knowledge into hard disciplinary silos, in favor of holistic translational ecologies of development. The historicity of the term favors a branding exercise of mountain studies rather than a completely new, alternative way to understand mountainscapes. I invite mountain scientists to consider adding fundamental and applied research dealing with the new approach to generate a stronger body of evidence in favor of montology. With the argument exhibited in the geoliteracy, ecoliteracy and sopholiteracy of current epistemologies, a new mountain ontology has been made evident.

I envision that students and mountain scholars of the greater South will actively contribute with reinforcing the need to develop the transdisciplinary science of montology for a sustainable mountain lifescape. After a paradigmatic shift requiring novel approaches studying mountain SESs, not only interdisciplinary or multidisciplinary, but also transdisciplinary, those crosscutting collective efforts are required to develop a sound understanding of the CASs of sustainable mountainscapes. It is also imperative to create new research networks and learning clusters, or to invigorate those already formed, to translate hard science into practice, just as much as the soft science smoothly favors power relations to shift in favor of development policies that are equitable and meaningful for studying mountain phenomena. By allowing all research done about mountains—whether from the physical or social sciences, the humanities, or the traditional and indigenous ecological knowledge—and its concomitant reification of mountain arts, politics and management, the affirmation of integrative work of montologists will secure the right path towards the sustainability of mountainscapes.

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