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The educational value of the history of geomorphology

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Abstract

The history of geomorphology can be a valuable tool for educating students of geomorphology. The largest and most available record of what geomorphologists thought and did in the past is their original published work. Also available are some fine papers on the history of geomorphology that review and analyze primary sources and past events in the discipline in order to generalize, explain trends, and reveal historical associations. Interest in the history of the discipline varies widely, of course, among geomorphologists. Nevertheless, several educational benefits, in addition to explaining the academic affiliation of geomorphology with two separate disciplines, can be derived from incorporating the history of geomorphology into university-level geomorphology courses. History is a popular subject, and presenting some geomorphic concepts using a historical approach can help to maintain or stimulate student interest. Because of the tendency for older literature to contain more qualitative description and methodological detail than more recent literature, undergraduate students may comprehend some concepts better from older papers. By reading the original literature, students determine for themselves what previous practitioners accomplished, rather than relying solely on the interpretations of others. Reading original literature also helps students realize that older does not mean less intelligent, and that like the critical reading of recent geomorphic literature, the critical reading of historic geomorphic papers can provide a wealth of new research ideas. A thematic set of the historic literature can be used to demonstrate to students the scientific method, the origin, testing, and evolution of hypotheses, how explanations develop in this field, and that science proceeds through individuals working in a sociological context. Including history of geomorphology in the curriculum helps to place contemporary research in the perspective of the past as well as the perspective of the future.

Keywords: History of geomorphology; Education; Historical approach; Teaching geomorphology; Geomorphology curriculum; Historic geomorphic literature

1. Purpose

This essay concerns the history of geomorphology and its value as a pedagogical device. After considering the nature of the historical record of the discipline and the degree of interest already shown by geomorphologists in the history of their field, the discussion focuses on the role of history in the education of geomorphology students. Although this account emphasizes North American geomorphology, the educational benefits derived from incorporating history into the teaching of the discipline are not restricted geographically (Walker and Grabau, 1993).

2. What constitutes the history of geomorphology?

2.1. When does the historical period begin and end?

Because this paper concerns what has happened in the past in the field of landform studies, it is appro-

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priate to consider when that history began (Davies, 1969). Some American geomorphologists would be tempted to start the clock with W.M. Davis (Fig. 1) and the explosion of interest in the subject near the end of the 19th century. Others might suggest it should begin with McGee (1888a,b), who is credited with the first published use of the term in English (Tinkler, 1985, p. 4). Is use of the word geomorphology, however, that important? Many geomorphologists might insist that the history of the discipline start instead in the 1870s to include G.K. Gilbert (Fig. 2), whose 1877 *Report on the Geology of the Henry Mountains* is widely considered to be the masterpiece of American geomorphic literature, and Powell (1875), who developed the concept of base level. One could argue going back farther, to the 1840s, to include Fremont (1845) for his geomorphic observations in the American Great Basin.

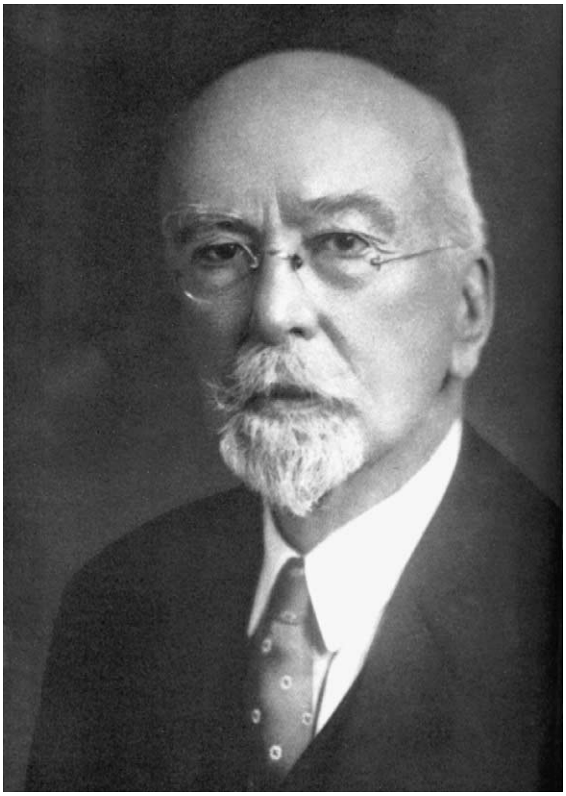

Fig. 1. William Morris Davis (1850–1934). Reprinted from Buwalda with permission. American Association for the Advancement of Science Copyright 1934.

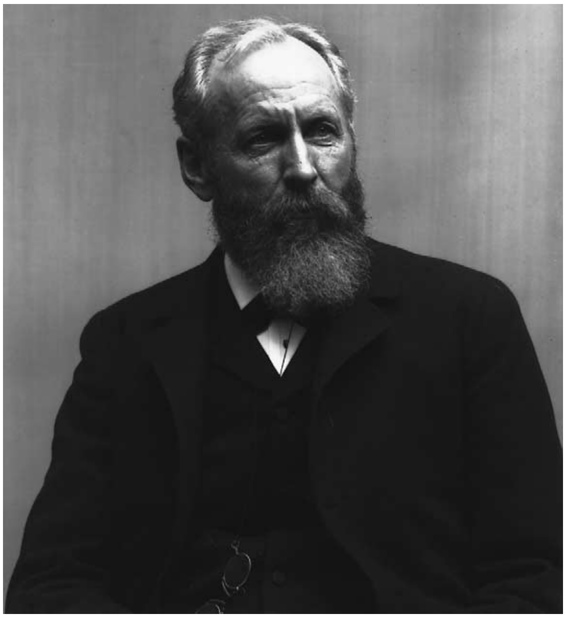

Fig. 2. Grove Karl Gilbert (1843–1918). US Geological Survey Photographic Library Portrait 129.

The affiliation of landform studies with the disciplines of geology and geography means that even earlier individuals significant in the history of those fields figure prominently in the history of geomorphology. Much has been written on the contributions to geomorphology of geologist James Hutton and his associate John Playfair from the late 18th and early 19th centuries (Chorley et al., 1964; Davies, 1969; Cunningham, 1977; Tinkler, 1985; Orme, 1989). Dean (1989, p. 73), in fact, argues that “we have good reason to associate the effective founding of geomorphology with Hutton’s name.” Geographers and geologists, however, have traced the intellectual lineage back much farther than the 18th century (Davies, 1969; Tinkler, 1985; Martin and James, 1993). Earlier European, Muslim, Chinese, and Ancient Greek contributions to landform studies have been documented, and most geomorphologists would probably agree with Martin and James (1993) that Early People must have acquired and used some understanding of landform elements.

“When does the history of geomorphology start?” then is perhaps best viewed as a rhetorical question that has an arbitrary answer. The specific starting point will vary depending on the purpose in attempting to select one. Likewise, at the other end of the time span, no agreement apparently exists on how old a publication must be in order to be considered of historic interest, despite the practice in some libraries of removing bound journals from the stacks and placing them in storage, like antiques, an arbitrary 20 years after the date of publication.

2.2. Primary and secondary sources

Materials that reveal what has happened in the past in geomorphology consist of primary and secondary sources. The most abundant and accessible record of what geomorphologists thought and did in the past is their original published work. Conference and symposium abstracts and programs can also be good sources of historical information (Association of American Geographers, 1950; Vitek, 1989; Sack, 1992). Comment and Reply and Letters to the Editor sections of journals should not be overlooked as sources of insight into the arguments made over key geomorphic concepts. With rare exceptions (e.g., Hunt, 1982, 1988) personal correspondence, diaries, and field or lab notes remain unpublished and, therefore, much more difficult to access than an individual's publications. If acquired, such material may provide exceptional glimpses into the personality of a geomorphologist or the development of a geomorphic concept.

Secondary literature concerning the history of geomorphology is also available. These books, articles, and essays review and analyze primary sources, ideas, and events of the past. They may summarize, generalize, highlight, interpret, explain trends, and/or indicate historical associations. Although thought-provoking and extremely valuable compilations, whether written by historians of science (i.e., trained as historians) or by scientist–historians (i.e., trained as scientists), secondary literature is influenced to varying extents by the interests, priorities, goals, and viewpoints of the authors (Greene, 1985; Brush, 1995).

3. How interested are geomorphologists in the history of their field?

Are most geomorphologists interested in the history of the discipline and aware of its merits as a pedagogical device? The educational value of the history of geomorphology has received very little attention in the literature. This suggests that its pedagogical role may be a concept that many geomorphologists have not considered.

Interest in the history of geomorphology undoubtedly varies widely among geomorphologists. At least one American geomorphologist, for example, declared that he had never read anything by G.K. Gilbert, nor did he have any intention of ever doing so (Anon., 1992, oral communication). On the other hand, a few geomorphologists have published both on the history of their discipline (e.g., Stoddart, 1976, 1994; Tinkler, 1987, 1989b; Harbor, 1989; Sack, 1989, 1992; Baker, 1996) and on the results of their more traditional scientific research (e.g., Stoddart, 1969, 1990; Harbor, 1992, 1995; Baker et al., 1993; Sack, 1995, 1999; Tinkler, 1997a,b). Geomorphologists who include some historical background in their scientific publications or who provide pertinent older, in addition to recent, references probably have an interest in the history of geomorphology. In many cases, however, it may be difficult to assess the degree to which an individual is interested in the history of the discipline from his or her publications alone. This occurs because some mentors, editors, and reviewers may discourage historical content and because not all geomorphologists are well published.

A second indication of the amount of historical interest within the discipline comes from the number of geomorphologists who belong to relevant historical associations, such as the History of Earth Sciences Society (HESS), the History of Geography Specialty Group of the Association of American Geographers (AAG), and the History of Geology Division of the Geological Society of America (GSA). For 1999, 15 of the more than 300 members of the international society dedicated to the study of the history of the earth sciences, HESS, were geomorphologists. Information from the AAG revealed that 20 individuals had joined both the Geomorphology Specialty Group ($n=398$) and the History of Geography Specialty Group ($n=135$) in 1999. At the end of the same year, 144 of the 1922 members of the Quaternary Geology and Geomorphology Division of the GSA also belonged to its History of Geology Division, which had 476 members. From these data it can be inferred that roughly 5–10% of geomorphologists have an expressed interest in the history of their discipline.

Another way to evaluate how interested geomorphologists are in the history of the discipline is to examine the historical publications that they have authored. Geomorphologists have written a few books on the history of their field, including the three-volume *History of the Study of Landforms* by Chorley et al. (1964, 1973) and Beckinsale and Chorley (1991), Davies' (1969) *The Earth in Decay*, Cunningham's (1977) *The Revolution in Landscape Science*, and Tinkler's (1985) *A Short History of Geomorphology*. In addition, Davis (1927) prepared a detailed, book-length memoir of Gilbert for the National Academy of Sciences, and Bagnold (1990) penned an autobiography. Dozens of historical articles written by geomorphologists have been published in edited volumes (e.g., Yochelson, 1980; Tinkler 1989a; Walker and Grabau, 1993) and in journals, including the *Annals of the Association of American Geographers*, *British Journal for the History of Science*, *The Canadian Geographer*, *Earth Sciences History*, *Geological Society of America Bulletin*, *Geomorphology*, *History of Science*, *The Journal of Geological Education*, *The Professional Geographer*, *Zeitschrift für Geomorphologie*, and others. Notably, historical publications authored by geomorphologists have been quite positively received by historians (e.g., Greene, 1989; Laudan, 1992; Bloom, 1993), who often tend to view scientists as having insufficient training in the methods of historical research (Greene, 1985).

Finally, the amount of historical background presented in general geomorphology textbooks provides a measure of how critical to the educational process these authors as a group consider history to be. Table 1 lists the 26 textbooks consulted for this analysis. The evaluation was limited to books that cover the full range of geomorphic subfields, as opposed to those that focus, for example, on only fluvial or coastal geomorphology. Slightly more than half of the listed textbooks, 15, contain sections that are dedicated to the history of geomorphology and which are used to set the subject in historical context. Five other textbooks either supply a smaller amount of historical context within the course of the narrative or present a historical account of the development of at least one geomorphic concept without providing historical context to the field as a whole. The remaining six textbooks do one of three things. They include virtually no mention of history, contain some nongeomorphic historic information, or cite some historic geomorphic references without discussion. Like individual geomorphologists, then, geomorphology textbooks differ in the amount of attention paid to the history of the discipline. About 75% provide historical information on at least the development of a major geomorphic concept. Authors (or editors) of the other 25% of the surveyed textbooks apparently find history inconsequential or irrelevant.

Table 1
General geomorphology textbooks checked for history of geomorphology content

Substantial historical account	Restricted historical account	Little to no outright historical discussion
Bloom, 1969	Derbyshire et al., 1979	Dury, 1959
Bloom, 1978	Embleton and Thornes, 1979	Rice, 1977
Bridges, 1990	Ritter et al., 1995	Scheidegger, 1970
Butzer, 1976	Ruhe, 1975	Twidale, 1976
Chorley et al., 1984	Twidale, 1968	Weyman and Weyman, 1977
Easterbrook, 1999		Wooldridge and Morgan, 1959
Garner, 1974		
Pitty, 1971		
Selby, 1985		
Small, 1970		
Sparks, 1972		
Summerfield, 1991		
Thornbury, 1969		
Tuttle, 1970		
Vann, 1971		

4. A note on textbook accounts

As with other secondary sources, historical accounts in geomorphology textbooks can be whiggish (i.e., presentist; viewing the past in terms of the present), revisionist, selective, celebratory, or propagandist; textbooks, however, are probably less likely to strive for an understanding of the past from the perspective of the past, that is, to exhibit historicism or contextualism (Greene, 1985; Brush, 1995). According to Greene (1985, p. 99) "the most difficult material to evaluate historically is the literature of attack and defense, as it is rarely advertised as such and usually wears the somber garb of calm reconsideration, particularly in the opening chapters of a textbook."

Those geomorphology textbooks that have considerable historical information differ substantially in the style of that presentation. Butzer's (1976, p. 10) account of Davisian geomorphology, for example, reveals more about his views than those of Davisian geomorphologists:

> Known as 'the cycle of erosion,' it was forced upon all landscape evolution.... ... In the end, an observational science was reduced to a parlor game of inductive reasoning that could be mastered by a freshman student.

In addition to forced, reduced, and parlor game, other value-laden words and phrases that Butzer (1976, p. 9–10) associates with Davisian geomorphology include: slowed progress, fault (as in blame), ignore significant advances, inhibiting, subjected the discipline to, no resemblance to empirical reality, semantic bickering, confused, and death of sterility. In contrast, he describes geomorphology in the post-Davisian era with the words pragmatists, all to the good, clear the air, surge, intensified, new techniques, unimpeded by theoretical ballast, more refined concepts, increasing value, new theoretical models, change, modernization, long overdue, little consensus, and pluralistic (Butzer, 1976, p. 10). Sparks (1972), however, offers a different view of approximately the same topic. Regarding the geographical cycle, Sparks (1972, p. 7) states that:

> This concept and some of Davis's other ideas have been criticized severely, as later work has proved that his ideas were not always correct. It must be stated, however, that much of the criticism appears to have arisen through an insufficiently thorough acquaintance with Davis's work, which is not as rigid and limited as some of the criticism would suggest.

As these two examples illustrate, readers must be aware that secondary accounts are not always neutral or objective, especially when history is not the main purpose of the work, as is the case with textbooks.

5. How is the history of geomorphology educational?

Several educational benefits derive from incorporating the history of geomorphology into university-level geomorphology courses. One benefit is that it helps to explain the association of geomorphology with two academic disciplines, geology and geography, a concept that seems to perplex many students as well as most faculty members who are not geomorphologists. The dual affiliation of geomorphology in the US largely reflects the influence of W.M. Davis, whose life and work are detailed by Chorley et al. (1973). Trained by geologists Pumpelly, Shaler, and Whitney at Harvard University, Davis received his BS degree in 1869 and a master's degree in Mining Engineering in 1870 from that institution. In 1878, Davis accepted an appointment at Harvard as instructor of physical geography, which at that time, before the establishment of academic departments of geography in the US, was typically taught by geologists (Martin and James, 1993). Davis was promoted to assistant professor of physical geography in 1885, one year after he first introduced to the academic community his evolving notions concerning landscape change. By calling his full-fledged, widely accepted theory of landform development the geographical cycle, Davis (1899) ensured the association of geomorphology with the subject area of geography, which was soon to emerge as an independent academic discipline, due in no small part to his tireless promotion of geography (e.g., Davis 1889, 1893, 1894, 1895, 1902). Davis, in fact, is considered the father of American academic geography because he actively championed both the establishment of a professional field of geography and improved geographic education at all levels (Beckinsale, 1981). He was a founding member of the AAG, its first president, and the only person who has served in that capacity for three terms. On the other hand, Davis's geological roots and his association with Harvard's geology department until his retirement in 1912 probably helped ensure geology's retention of landform studies. Thus, history explains why the study of landforms in the US lies in geography as well as geology.

Incorporating history into a course stimulates student interest because, in general, students like history (Wright, 1965; Sack and Petersen, 1998); people have a natural curiosity about the past (Tinkler, 1985). Although the number of university degrees earned in history has declined in the US since about 1970 and some students may take a history class only if it fulfills a requirement, history courses remain popular among both university and secondary school students

(National Center for Education Statistics, 1984; Hill and LaPrairie, 1989). Even upper elementary school children have ranked history as their favorite social studies subject (Sack and Petersen, 1998). Historical accounts, which often have a strong biographical component, give an appealing variation to the format of university geomorphology classes, which typically consist mostly of students who do not intend to become professional geomorphologists. This variation in format helps hold student interest and attention so that they may learn and retain more. Student interest can also be heightened by the tendency for the historical approach to show science as a process of discovery rather than as a set of definitions and explanations. Biography is a particularly powerful pedagogical vehicle for revealing the content and nature of a scientific discipline because people relate to and seek to understand other individuals (Camerini, 1997). The historical–biographical approach helps students view the field in a more humanized and personal way and demonstrates how science proceeds through individuals working in a social context.

"The insights gained by closely examining our past can provide the most enlightening view of our present and our science" (Richards, 1995, p. 123). History, in other words, furnishes context and perspective for the current status of an academic discipline (Tuttle, 1970; Richards, 1995). Understanding how past geomorphic concepts were products of their time helps students realize that current geomorphic concepts are likewise products of the present time. By seeing how previous notions have been subsequently modified and replaced, students learn that contemporary notions will also be modified and replaced and that, like their predecessors, contemporary scientists do not possess ultimate geomorphic understanding.

History may be a crucial component of the geomorphic curriculum. The constructivist approach to science education contends that to learn, a science students must develop their own conceptualization of how that science works, and history is an excellent source of information on that process (Nersessian, 1995). Showing students the historical steps that led to the solution of a geomorphic problem helps them construct their mental image of the discipline. Many geomorphology students, though, are future makers of environmental policy rather than future geomorphologists. Policy Makers must understand the social as well as the technical structure of the science of geomorphology because it is fundamental to mitigating and solving many environmental problems. Policymakers can learn a great deal about how the science operates by studying its history (Hall, 1976). History, for example, helps explain the affiliation of geomorphologists with specific academic departments, government agencies, and professional societies; understanding the organizational structure of the profession helps policymakers locate geomorphologists. History also demonstrates why careful data collection, fieldwork, and technological innovation are so important to geomorphologists. It underscores to policymakers the value of professional meetings and symposia in disseminating the latest information, methods, and techniques. By depicting how geomorphologists have contributed in the past to the assessment and mitigation of fluvial, mass wasting, coastal, tectonic, and other hazards, history indicates an array of present public environmental problems that geomorphologists can tackle and it shows how the science can influence public policy.

6. The importance of primary sources

Those individuals who have researched and written the excellent books and monographs available on the history of landform studies have probably each spent thousands of hours identifying, locating, acquiring, studying, thinking over, and writing about a multitude of published and unpublished primary sources. The rest of the geomorphic community benefits greatly from having the distillation of that tremendous effort readily available as secondary compilations. All geomorphologists cannot read all of the historic primary geomorphic material, nor should they be expected to. Secondary sources, however, can suffer as well as benefit from generalization (Sack, 1991), and there are compelling pedagogical reasons to incorporate some history of geomorphology into landforms classes through reading assignments of original published work by geomorphologists from the past.

Compared to contemporary articles, most older papers contain a tremendous amount of methodological detail expressed in a predominantly qualitative style that is easy for undergraduate students to comprehend. Gilbert's (e.g., 1886, 1890, 1896, 1904) papers, for example, describe in great verbal detail the geomorphic feature or process under study, what explanations were hypothesized, which failed various scientific tests, why they failed those tests, and which explanations remain viable. Thus, in at least some cases, students can learn geomorphic concepts and methods more readily from older literature than from contemporary ultraconcise "least publishable unit" (lpu) papers that often assume a readership with an advanced technical background.

By reading older published papers, students learn for themselves what previous workers stated and accomplished. Reading, moreover, is a very personal activity. Reading older geomorphic papers directly allows students to personally experience a piece of the history of the discipline, which will leave a deeper impression than if they are merely told about it by others. Even though some of the notions of earlier geomorphologists may no longer be accepted, in many cases their writings reveal that they were intelligent, logical, thoughtful, perceptive, and/or insightful. In gaining respect for the scholarship of preceding geomorphologists, students gain respect for the discipline as a whole. From primary sources students may also discover that widely accepted historical interpretations can be whiggish, agenda-driven, or simplified to the point of being incorrect (Herries Davies, 1989). Exposure to primary sources, for example, reveals that the antithetical characterization of Gilbert and Davis that arose in the second half of the 20th century obscures Davis's geological affiliations as well as Gilbert's contributions as a geographer and educator (Sack, 1991).

Historic primary publications are excellent sources of geomorphic information and research ideas for undergraduate students, graduate students, and professionals. Previous generations of geomorphologists often expres-sed in a qualitative way concepts that can later be described and analyzed quantitatively (e.g., Drew, 1873; Bull, 1962). Geomorphic predictions, partially developed ideas, overlooked notions, and concepts long considered irrelevant lie in historic literature waiting to be rediscovered (Greene, 1989), tested, reconfigured, augmented, or applied in a new way. Probably most of the mid–20th century geomorphologists who read Gilbert's (1917) paper on hydraulic-mining debris wondered if his predictions regarding sediment storage and mobilization had come true, yet the opportunity to test his sediment transport model was not seized until late in the 1980s (James, 1988, 1989). Historic research papers have plenty of fuel to spark the present research imagination. Older writing styles may actually engender creativity if they cause readers to think about familiar topics in, what is to them, a different way. In addition, a thorough review of previous literature, including the historic, must be conducted on potential research topics to set the new project in perspective and avoid unnecessarily repeating work that has already been completed.

Studying a thematic set of primary sources can help students understand the scientific method, how ideas develop in this field, the evolution of hypotheses and explanations, and that geomorphology, like other sciences, proceeds in a sociological context (Kuhn, 1962). Historic papers assigned in a principles of geomorphology class might include Gilbert's (1886) thoughts regarding the scientific method, Davis's (1899) presentation of the geographical cycle, and an example of Gilbert's (e.g., 1904) continued use of his method of multiple working hypotheses long after his methodological statement on the topic. The geomorphic ap-proaches and styles of those two individuals could also be experienced by students in a thematic geomorphology class, such as arid-lands geomorphology (e.g., Gilbert, 1896; Davis, 1905). It is suggested that graduate students in a fluvial geomorphology seminar read first-hand frequently cited historic papers, such as those by Gilbert (1877), Davis (1899), Horton (1945), and Mackin (1948). Other suggested readings important to the history of the field include papers by Strahler (1950a,b, 1952), Hack (1960), Wolman and Miller (1960), Chorley (1962), and Schumm and Lichty (1965).

In-class student discussions and thematic writing assignments are effective means for focusing undergraduate student attention on various aspects of reading assignments from the historic geomorphic literature. These activities can take numerous forms including, for example, comparing content, style, and impact of papers written in different periods, tracing the evolution of a geomorphic concept through time, and staging mock debates among historical figures over a geomorphic issue.

7. Summary

Incorporating the history of landform studies into geomorphology classes has several educational advantages. It can be used to explain the disciplinary affiliation of geomorphology with both geography and geology, maintain a high level of student interest in the subject, teach future policymakers as well as future geomorphologists about how the discipline functions, and provide context for and perspective on the present state of the field. What geomorphology is today stems in part from what it was in the past. Understanding past geomorphic ideas, how they were products of social and intellectual environments, and how they have changed over time helps present geomorphologists realize that current notions are likewise influenced by complex factors and are subject to change.

Although difficult to assess, professional geomorphologists in recent years have shown some interest in the history of the field through memberships in historical associations, the amount and quality of historical research publications, and the content of geomorphology textbooks. Regardless of when the history of geomorphology is said to start or end, as with the earth itself, geomorphologists know much more about the recent than the older history of the field. The largest and most accessible record of what previous geomorphologists thought and did is the original published work of geomorphologists from the relatively recent past. Some excellent and well-received secondary sources on the history of landform studies are also available. Historical accounts presented in geomorphology textbooks vary greatly in length and in the style of presentation. Compared to other secondary sources, these accounts may be especially prone to propagandize or advance a present agenda (Greene, 1985), in some cases revealing more about the views of the textbook author than those of the past geomorphologists being discussed. Although many secondary sources are invaluable and thought-provoking distillations of numerous primary materials, they all suffer as well as benefit from generalization.

Primary sources are an especially valuable means of delivering the historical component to geomorphology students. Students can learn much about geomorphic concepts and methods from the many older papers written in great, primarily qualitative, detail. By reading the original literature, students learn to draw their own conclusions about the accomplishments of past geomorphologists instead of relying solely on the interpretations of secondary sources. Studying older work is an integral part of research because it stimulates new ideas and helps ensure that a proposed project is not reinventing the wheel. Historic literature can also be used to show students the scientific method and how geomorphic concepts change through time. Reading history, like reading in general, however, is a very personal experience, and every paper will affect each reader differently.

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