

WHAT GEOSCIENTISTS CITE: A COMPARATIVE SURVEY

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Abstract – In the course of a citation study of USGS publications (Butkovich and Musser, 1993) it was noted that certain types of references such as personal communications and unpublished materials were not included in the bibliography but rather in the text, thus complicating the process of citation analysis. This paper investigates the phenomenon further and compares the citation styles used by geoscientists with styles used in other disciplines. Results indicate that geoscientific styles differ from those of many other disciplines resulting in a devaluation of unpublished materials within the geoscience community.

THE PURPOSE OF CITATION

In general, citations are used to provide documentation or support for specific statements. Citations tie current research with discoveries of the past and support replication of work. Other reasons for citation include giving credit to previous researchers, substantiating claims, criticizing or correcting previous work, providing background reading and context, and providing leads to poorly disseminated work (Garfield, 1983, p. 548).

Citations not only link related works, they also provide insight into what resources researchers use and which are used most heavily. These additional ways in which citations are used are significant. Citation to a particular author's work is a factor in assigning prestige and is frequently used in evaluating researchers for awards or other accolades. Librarians use citation information about specific journal titles to inform acquisition and retention decisions and assign value. An example of a value assignment is the journal Impact Factor (ISI, 2003), a calculated figure indicating the relative impact of a particular journal on that field. Librarians use citation studies to determine the formats and ages of materials used by researchers, from which the results are used to inform collecting and preservation decisions. It is an underlying assumption of most citation analyses that the references from the bibliographies of works analyzed are generally complete. If this assumption is incorrect, then the results of these citation analyses and the actions taken thereupon are called into question.

While there have been many citation studies of the geoscience literature, many of them do not

analyze the format of the references cited. Nine studies were found that reported on the formats of the references cited based upon references in the bibliography (Butkovich, Gomez and Baker, 1992; Butkovich and Musser, 1993; Craig, 1969; Gross and Woodford, 1931; Kapor, 1984; Laosunthara, 1956; Lifshin, 1993; Thuronyi and Rigby, 1966; Walcott, 1991). These studies consistently measured citation to personal communications and other unpublished materials at approximately one percent. In contrast, Butkovich and Musser found that, when the references in the text were included in the analysis, usage of these formats was measured at eight percent. While that study may not be definitive, it implies that citation styles can have a significant impact.

In that 1993 study of USGS publications, Butkovich and Musser found that references to personal communications, unpublished data, and primary sources such as specimens and manuscripts were omitted from bibliographies and mentioned only in the text of the works. Why was this so? Clearly, the authors of these publications were following the citation style as outlined in the Suggestions to Authors of Reports of the United States Geological Survey. But why would the style guide authors recommend this? Could it be that the community of researchers is assumed to be so small that everyone knows everyone else and where things are, thus obviating the need for citation? Is it a case of the implicit citation where, for example, a paper about the bones of T. Rex 'Sue' includes no reference to the specimen itself, or the obliteration phenomenon, whereby a collection or person has become so well known that no one bothers to cite it in the bibliography any longer (e.g., Wegner's theory of continental drift)?

THE HISTORY OF CITATION AND THE EMERGENCE OF STYLE MANUALS

The answers to these questions may lie in the history of citation itself. Science in the eighteenth century was largely based upon personal communication and references were made to the person rather than the work. The citation emerged as part of the organization of science in the nineteenth century and while references appeared in the literature they were frequently undated (Leydesdorff, 1998). This remained the norm until the twentieth century when the number of references per paper took off and a standard system of citation began to appear.

Style manuals were an attempt to standardize practice among researchers and to establish norms for disciplines whose literature had grown large enough that norms were desired. At the beginning of the twentieth century there were a mere handful of style manuals in existence. The USGS published its first style guide in 1909. By the end of the century there would be over 1000 style manuals in existence.

In order to determine whether the practice of not citing personal communications and other unpublished materials (including primary sources) is universal across disciplines, style guides from many disciplines were compared as to their guidelines for these materials. The findings are presented in Table 1.

DISCUSSION

There is a high degree of uniformity in the citation styles for these materials in geoscience style manuals. Consistently, geoscience authors are instructed to omit from the bibliography any references to personal communications and unpublished materials. In comparison, guides to other scientific disciplines differ from the geosciences by encouraging citation to unpublished materials, with most recommending citation of personal communications. The arts and humanities and general style manuals differ more consistently from the geoscientific style by recommending citation of both personal communications and unpublished materials. No other discipline consistently replicated the geoscientific style of not citing personal communications and unpublished materials. Why should this be so?

To some extent, this can be traced to the history of citation itself, which began as circles of correspondence, grew to references to colleagues before finally evolving into references to particular works. The omission of references to unpublished

materials such as specimens or collections may be viewed in part as a kind of implicit citation, where the author assumes the reader knows about a person or collection, its location and other particulars, as was frequently the case among pre-twentieth century geoscientists.

A stronger reason for this phenomenon emerged, however, from the examination of the geoscience style guides. These guides made a point of indicating that, if materials were not 'conveniently available' (U.S. Geological Survey, 1958, p. 106), then they should not be cited in the bibliography. There seems to be a sense that, as a courtesy to colleagues, resources that are inaccessible or irreplicable should not appear in the bibliography, a sentiment that was echoed in some other disciplines as well.

There are signs of change in the geoscientific community, however. The editors of the Geological Society of America Bulletin now encourage authors to cite proprietary data even though it is potentially inaccessible (Geological Society of America, 2002, p. 6). The World Data Center for Paleoclimatology provides a suggested format for citing unpublished WDC data and strongly encourages its use (WDC, 2002).

Why is change necessary? Beyond the fact that the geosciences are out of step with the rest of the scholarly community, the omission of citations to unpublished materials serves to de-value their importance to the geoscientific community, a fact alluded to in the 2002 NRC report on the preservation of geoscience data and collections (National Research Council, 2002, p. 67). Without citation, assessments regarding the value of particular unpublished materials such as specimens and collections are made more difficult. The Ocean Drilling Program (and its predecessor Deep Sea Drilling Project) provides a good case in point. The ODP is a government funded program that collects rock cores from the ocean floor. In 2002 an ODP citation database was created in an attempt to document the uses of ODP data in order to justify continued funding and support (ODP, 2002). This was necessary because there existed no tradition in the geoscientific community for giving credit and acknowledging the value *via citation* of unpublished material, in this case cores.

In conclusion, this examination of style manuals confirms that the standard citation styles used by geoscientists are inconsistent with those of other disciplines. Lack of citation to personal communications and other unpublished materials misleads scholars new to the field, historians of science, and others interested in the preservation of the research resources of the geosciences. It makes it harder to replicate work and trace influence. Finally,

lack of citation has led to a devaluation of these resources and threatens their very existence. Geoscientists must join the twentieth century (not to mention the twenty-first!) and acknowledge, via citation, their reliance on unpublished materials in their research.

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Table 1: Style manual recommendations for unpublished materials such as personal communications, specimens, and data. (Style manuals that did not discuss how to treat unpublished materials were omitted from this table.)

Title	Discipline	Cite in bibliography?	Notes
GENERAL STYLE MANUALS			
Chicago Manual of Style. 14 th ed. Chicago: University of Chicago Press, 1993.	General	Yes	Gives instructions on how to cite personal communications, manuscripts and other materials in collections, including non-print sources.
A Manual for Writers of Term Papers, Theses and Dissertations. 6 th ed. / Kate Turabian. Chicago: University of Chicago Press, 1996.	General	Yes	Gives instructions on how to cite unpublished materials such as speeches, letters and performances. "Actual works of art are normally not included in ... a reference list." p.212
Oxford Guide to Style. / R. M. Ritter. New York: Oxford University Press, 2002.	General	Yes	Describes how to cite manuscripts and other documentary sources such as unpublished materials and personal communications.

American National Standard for Bibliographic References. ANSI Z39.29 New York: American National Standards Institute, 1977.	General	Yes	Describes how to cite unpublished works such as letters, and works of art. Personal communications are excluded from the scope of this standard unless they are in a 'finite recoverable form'.
Information and Documentation – Bibliographic References – Content, Form and Structure. ISO Standard 690. 2 nd ed. International Organization for Standardization, 1987.	General	N/A	Does not apply to manuscripts or other unpublished material.

GEOSCIENCES			
Suggestions to Authors of the Reports of the United States Geological Survey. 7 th ed. Washington, DC: GPO, 1991.	Geosciences	No	First instructions referring to unpublished data appeared in the 5 th ed., 1958. "All reports listed as references must be reasonably available to the public. Unavailable reports should not be cited." p.234
Guide to Authors – A Guide for the Preparation of Geological Maps and Reports. Rev. ed. Ottawa: Geological Survey of Canada, 1980.	Geosciences	No	"Only material that has been published ... should be cited in the reference list." p.17 "Unpublished material or personal communications should be identified as such in the text... but are not to be included in the reference list." p.17
A Writing Guide for Petrological (and Other Geological) Manuscripts. / T. Neil Irvine and Douglas Rumble III. Supplement to the Journal of Petrology. New York: Oxford University Press, 1992.	Geosciences	-----	Nothing mentioned.
Geowriting. 5 th ed. Alexandria, VA: American Geological Institute, 1995.	Geosciences	unclear	States that the list of references should include "information that will enable a person to locate the reference if it is unpublished." p.19
Style Sheet for the Scientific Serial Publications of the American Museum of Natural History. 2 nd ed. / Ruth Tyler. New York: American Museum of Natural History, 1953.	Geoscience (Museum)	-----	No specific mention of references to unpublished materials. The introduction should "include the acknowledgments ... for specimens borrowed..." p.12
Style Manual: Scientific Serial Publications for the American Museum of Natural History. 3 rd ed. / Brenda Jones. New York: American Museum of Natural History, 1988.	Geoscience (Museum)	No	"It is strongly suggested that authors do not list unpublished material in the References unless they can specify where that material can be located. Letters, unpublished information, and other forms of personal communication are best cited in the text only." p.23-4

OTHER DISCIPLINES			
Arizona State Museum Style Guide. 2 nd ed. / Carol A. Gifford and Carol Ann Heathington. Tucson, AZ: Arizona State Museum, 1989.	Anthropology (Museum)	No.	"Do not cite anything that is not available to the reader..." p.19 "Reference to use of specimens should be included in the introduction." "Personal communication references are never used." p.20
Guide to Citing Primary Resource Materials. Franklin D. Roosevelt Presidential Library and Museum. http://www.fdrlibrary.marist.edu/citing.html Accessed 10 February 2003.	Archives	Yes.	Describes how to cite primary resource materials such as letters and photographs.

A Short Guide to Writing About Art. 5 th ed. / Sylvan Barnet. New York: Longman, 1997.	Art	Yes	Describes how to cite primary sources such as specific works of art as well as personal communications. Gives specific instructions on how to cite illustrations in captions, including location of original works.
Scientific Style and Format: The CBE [Council of Biology Editors] Manual for Authors, Editors, and Publishers. 6 th ed. New York: Cambridge University Press, 1994.	Biology	Yes	Describes how to cite personal communications. Upcoming 7 th ed. contains examples of citing Internet communications such as email, chats, and real-time communication.
Guidelines for the Preparation of Botanical Taxonomic Papers. / HJ. Eichler. Melbourne, Australia: Commonwealth Scientific and Industrial Research Organization, 1977.	Botany	Yes/No	List specimens examined in the references. "Personal communications may be referred to in the text but should not be included in the list of references." p.14
ACS Style Guide. 2 nd ed. Washington, DC: American Chemical Society, 1997.	Chemistry	Yes	Describes how to cite unpublished materials.
The SBL [Society of Biblical Literature] Handbook of Style: for Ancient Near Eastern, Biblical, and Early Christian Studies. Peabody, MA: Hendrickson, 1999.	Classics	Yes	Describes how to cite primary source materials.
MLA Handbook for Writers of Research Papers. 4 th ed. New York: Modern Language Association of America, 1995.	Languages	Yes	Describes how to cite objects and personal communications.
The Bluebook: A Uniform System of Citation. 17 th ed. Cambridge, MA: Harvard Law Review Association, 2000.	Law	Yes	Describes how to cite unpublished materials such as interviews, letters, and non-print resources.
American Medical Association Manual of Style. 9 th ed. Baltimore: Williams and Wilkins, 1998.	Medicine	Yes/No	Shows how to cite unpublished materials. "Do not include personal communications in the list of references." p.46
National Library of Medicine Recommended Formats for Bibliographic Citations. / Karen Patrias. Bethesda, MD: National Library of Medicine, 1991.	Medicine	Yes	Gives examples of how to cite personal communications. "Some communications may be best handled in the text or as footnotes." p.87
AIP Style Manual. 4 th ed. Melville, NY: American Institute of Physics, 1990.	Physics	Yes	Provides examples of references to personal communications and other unpublished works.
The Political Science Student Writer's Manual. / Gregory M. Scott. Englewood Cliffs, NJ: Prentice Hall, 1995.	Political Science	Yes	Provides examples of references to unpublished sources including interviews.
Style Manual for Political Science. Rev. ed. Washington, DC: American Political Science Association, 2001.	Political Science	No	Personal communications "are usually best indicated in the text or a note" p.26
Publication Manual of the American Psychological Association. 5 th ed. Washington, DC: American Psychological Association, 2001.	Psychology	Yes/No	Provides examples of how to cite unpublished works but recommends that personal communications be cited in the text only. "Because they do not provide recoverable data, personal communications are not included in the reference list." p.214
American National Standard for the Preparation of Scientific Papers for Written or Oral Presentation. ANSI Z39.16-1979. New York: American National Standards Institute, 1979.	Science	Yes	States that references to unpublished materials, including personal communications, should be made only when strictly necessary.

Citing Electronic Data Files. Inter-University Consortium for Political and Social Research. http://www.icpsr.umich.edu/ORG/citation.html Accessed 10 February 2003.	Social Sciences	Yes	"Publications based on ICPSR data collections should acknowledge those sources by means of bibliographic citations." "Data producers, funding agencies, and others can track citations to specific collections to determine types and levels of usage."
A Short Guide to Writing About Social Science. 4 th ed. / Lee Cuba. New York: Longman, 2002.	Social Sciences	Yes	Describes how to cite unpublished work.
Suggested Citation Styles for Our Internet Information. U.S. Census Bureau, 2001. http://www.census.gov/main/www/citation.html Accessed 10 February 2003.	Social Sciences	Yes	Describes how to cite personal email and data.
The Sociology Student Writer's Manual. 3 rd ed. / William A. Johnson. Upper Saddle River, NJ: Prentice Hall, 2002.	Sociology	Yes (optional)	Describes how to cite sources from interviews and materials in archives. References to unpublished sources such as personal communications are optional.