GUIDELINES FOR
SCIENTIFIC WRITING
ORAL PRESENTATION
READING SCIENCE

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MUST BE SLIGHTLY UPDATED

LIST OF PERIODICALS IN PELLETIER LIBRARY

To decrease the loss of periodicals, the bound and unbound journals have been moved to Pelletier Library. Because they are shelved with journals from other disciplines this list is provided to indicate which journals are of special interest to geologists and environmental scientists.

American Association of Petroleum Geologists Bulletin

American Journal of Science American Minerologist

American Society of Civil Engineer Hydraulic Division Journal

Association of Engineering Geologists Bulletin

Canadian Journal of Earth Sciences

Earth and Planetary Science Letters

Earth Surface Processes

Economic Geology

Environmental Geology

Geochimica et Cosmochimica Acta

Geological Society of America Abstracts with Programs

Geological Society of America Bulletin

Geology

Geotimes

Illinois State Geological survey Publications

Journal of Geology

Journal of Geophysical Research

Journal of Petrology

Journal of Paleontology

Journal of Sedimentary Petrology

Journal of Structural Geology

Marine Geology

Northeastern Geology

Rocks and Minerals

Sedimentology

Soil Science Society of America Journal

Tectonophysics

Water Resource Research

SCIENCE WRITING

General

The Writing of science reflects some difference in character, style, etcetera from other forms of writing you may have encountered.

Science or technical writing is utilitarian; its primary function is to communicate ideas or arguments coherently and efficiently. In some writing, complexity of sentence structure, provocative adjectives, etcetera may have a value and purpose in their own right. In some forms of writing it may be appropriate to write lengthily and to some degree, repetitiously, in order to evoke impressions and moods, or to paint in details of a complex image. In technical writing, length, repetition, provocative adjectives, and complexity of sentence and paragraph structure etc. <u>generally</u> retard the flow of development of argument or, description and are, <u>generally</u>, to be avoided. In some forms of writing, the language itself and of itself have a beauty. In technical and science writing, the beauty is primarily an attribute of the idea or argument being expressed, rather than of the language itself. Science writing is elegant to the degree that is simply, clearly, concisely, coherently, and efficiently expresses the idea or argument.

Remember that your primary objective is to communicate your observations, conclusions, and reservations as directly and simply as possible to your reader. You do not want to be ambiguous, such that he/she could misinterpret your statements. You don't want to hinder his/her comprehension by using convoluted language, or by using a "big" or unfamiliar word when a four-letter word (within the bounds of good taste) will do as well. Of all forms of writing, science writing probably most closely approaches in style and purpose, everyday conversation.

Some cautions or techniques in science writing are:

Be precise-words in science have precise meaning.

"Jargon" is a manifestation of this - to define a new thing, an existing word for another thing cannot be used - a new word is coined. Jargon words are not inherently more difficult to grasp than are others--and are not unique to science. If you didn't already know what "noun", "verb", "gerund", "past participle" and "split infinitive" meant, grammar would also have an awesome "jargon". Student difficulty with jargon largely results from it's unfamiliarity.

Everyday words are often used loosely in everyday conversation. For example, "hard" and "difficult" are used almost interchangeably. In science writing these two words mean quite different things. Use of one when the other should have been used will distort or obliterate the intended meaning of a sentence.

Some everyday words and phrases are to be avoided in science writing because of their ambiguity, or because they have connotations contrary to the assumptions and method of science. For example, do not write (or think) "I believe..." --sensu stricto, this implies faith, an unacceptable test of truth in science. Do not say (or think) "This proves..." or "These observations prove...". We cannot prove anything absolutely in science. We can only assess probability that something is true. Hence, say or write (and realize), "These observations **suggest (or "indicate" or "are consistent with")** this interpretation (or explanation or hypothesis)".

Be concise-

Science language should flow directly and logically (eg A and B were observed. These observations are consistent with interpretations C and D. However, observation E is inconsistent with D. Therefore, explanation C appears to be most probable). If you find yourself being repetitious, i.e., saying the same thing in different ways, it may indicate that you are not expressing the thing clearly. You are belaboring the expression and repeating it in an attempt to ensure its comprehension.

Rather, state it clearly--once. Generally, quotations are to be avoided. Their use is inefficient--often, their use reflects the fact that the writer doesn't truly understand the language quoted, hence cannot accurately paraphrase it, and seeks refuge in direct quote. Quotations are not necessary in science to certify proper use of authorities.

Organize Your Writing

Define the contribution precisely at the outset. State the purpose, give adequate (but not an overabundance) of background, present the data that led to the conclusions concisely, differentiate fact and inference clearly, present justifiable conclusions and perhaps further implications of the conclusions. In general, assume that readers are familiar with the general literature and need not be told basic principles. Concentrate on the contribution and present it clearly in the fewest words possible (avoid jargon), so that the reader may get a maximum of facts and ideas in a minimum of time.

The writing should develop arguments logically and directly. Do not insert parenthetical sentences into a series of otherwise continuously logical sentences. On the other hand, the writing should develop ideas completely. In taking notes, or highlighting by underlining in a text, students develop the habit of writing or seeing only the most important points in a discussion or argument. They are aware in their mind of other points or ideas which lead into, and tie together the main ones--but they often omit these lesser points in writing, even though they may be essential to the complete development of ideas. Your reader cannot read your mind--give him/her all the essential steps in an argument.

In science writing, details (eg. observations, measurements, etc.) may, if included in the text of writing, hinder and detract from continuity, and the direct efficient development of an idea. Often, therefore, observations are not listed in the prose, but are listed in organized fashion in tables of data, which the reader may consult when convenient for him/her. Also, in science writing, ideas and relationships may often be more efficiently and clearly presented in graphical, rather than verbal form. Pictures (diagrams, graphs, etc.) can give a reader an easily-comprehended synthesis or summary which, if parceled out piecemeal in a series of sentences, would be more difficulty-comprehended.

Some details and examples may be essential to a reader's understanding. Your writing should not consist only of a series of generalizations. Generalizations should generally be illustrated or exemplified to make their meaning clear. For example, "The characteristics of soil are determined by a wide variety of factors related to bedrock and climate." This statement is true--but it doesn't convey much to your reader without some examples of specific characteristics and the manner in which factors determined them.

Writing & Evaluating An Abstract

The abstract should present factual information and results in capsule form and should be brief and objective, containing within usually a 250-word maximum the content and conclusions of the paper. The topic sentence should give the overall scope and should be followed by emphasis on new information. Omit references, criticisms, drawings, and diagrams.

- Below are some additional comments concerning abstract preparation taken from "A SCRUTINY OF THE ABSTRACT" by Kenneth K. Landes

<u>This first paragraph is an example of an unacceptable style</u>

ABSTRACT

The behavior of editors is discussed below. Also, what should be covered by an abstract is considered. The importance of the abstract is described. Dictionary definitions of abstract" are quoted. At the conclusion a revised abstract is presented.

Presumably new editors, like new senators and small children, should be seen and not heard. But, unfortunately the Association has elected (the electorate had no choice) an editor who is a nonconformist. For many years I have fretted over the inadequate abstract, and now perhaps I can do something about it -- but not by keeping quiet.

<u>Many of the abstracts</u> appearing in the publications, including the meeting programs, of the A.A.P.G. can best be described by the use of a homely word that refers to an infestation by certain minute organisms. The abstract appearing at the beginning of this note is in that category. I regret to say that it is not an extreme case. My collection contains several that are worse. Dean Russell of Louisiana State refers to such abstracts as "expanded titles." They could also be looked upon as a table of contents, in paragraph form, with "is discussed" and "is described" added so as to furnish each subject with the verb necessary to complete the sentence. The reader is left completely in the dark not as to what the paper is about but as to what it tells! The information and the interpretation contained therein remain a mystery unless the reader takes the time to read or listen to the entire paper. Such abstracts can be likened to the "teaser" which your local movie manager shows you one week in the hope of bringing you back next week. But the busy geologist is more likely to be vexed than intrigued by the coy abstract.

To many geologists, especially to the tyros in exposition, the writing of the abstract is an unwanted chore required at the last minute by a rule-ridden editor or insisted upon even before the paper has been written by a deadline-bedeviled program chairman. However, in terms of market reached, the abstract is the most important part of the paper. For every individual who reads or listens to your entire paper, from ten to five hundred will read the abstract. It is much better to please than to antagonize this great audience. Papers written for oral presentation should be prepared with the deadline the abstract date instead of the delivery date. Later discoveries can be incorporated within the paper -- and they would miss the program abstract anyway.

<u>Remember for future use</u>:

My dictionary describes an abstract as "a summary of a statement, document, speech, etc." and *"that which concentrates in itself the essential qualities* of anything more extensive or more general, or of several things; essence." The definition I like best has been set in italics. May all writers learn the art (it is not easy) of preparing an abstract containing the essential qualities of their compositions! With this goal in mind I append an abstract that I believe to be an improvement over the one appearing at the beginning of this discussion.

This paragraph is an example of a correct abstract style:
The abstract is of the utmost importance, for it is read by 10 to 500 times more people than hear or read the entire article. It should not be a mere recital of the subjects covered, replete with such expressions as "is discussed" and "is described." It should be a condensation and concentration of the essential qualities of the paper.

CITATIONS OF AUTHORITY
Writing may concern a subject area in which other workers have previously developed generally accepted conclusions. These other workers are then authorities and their conclusions may be repeated without rehashing their observations and arguments. That is not to say that these conclusions have become dogma. Rather, for the purpose of the moment, the conclusions are accepted as true for the sake of efficiency. In this case, or in any case in which we refer to earlier work, or paraphrase or assume earlier conclusions, we acknowledge the original worker or author--not by quotations, or footnotes, or endnotes, but by a simple reference in the text of the writing, and a listing of sources under the title "References Cited" eg.
Very important:
1) References mentioned in the text, figures, captions, tables, and appendixes must be listed in the References Cited section.

2) Only references for those cited in the body of the paper are to be listed in the **References Cited** list.
Under References Cited, list the references alphabetically by author's surname. For references with two authors, list alphabetically by first author and then alphabetically by second author. For references with more than two authors, list alphabetically by first author and then chronologically, earliest year first. Spell out journal titles in references. For references that do not match any of the examples given here, write out all information that would help a reader to locate the reference.

3) See other handouts entitled **"Rules for Citing and Listing References**" and **"Writing Check List"**for correct styles of referencing.

EXAMPLE OF AN OUTLINE (TABLE OF CONTENTS) FOR A MANUSCRIPT or SENIOR PROJECT ("comp")

Contents .... Page

DESCRIPTION OF METHODS.
Provide descriptions of such things as methods and laboratory techniques in as brief a form as possible (preferably as an Appendix). Do not describe standard methods in detail if references to the methods can be cited.

MISCELLANEA - UNITS OF MEASURE, ILLUSTRATIONS, TABLES, CAPTIONS, ETC.

Units of Measure. Use the International System of units (metric) in captions, illustrations, and text. Where English measurements are necessary, follow metric with English in parentheses.

Footnotes. Avoid footnotes and parenthetical statements. Textual footnotes that are deemed necessary should be numbered consecutively with superscripts and also typed double-spaced.

Captions. Make cations precise and explain all symbols used. Type captions in consecutive order

Tables. **Tables should replace text, not duplicate it.** They should be numbered consecutively, and each typed on a separate page. Table 1 provides further instructions.

TABLE 1. SAMPLE TABLE--USE ALL CAPITAL LETTERS FOR TITLE.

Use a zero before .... decimal point .... for values <1 .... (measurement unit)	Align decimal points; use commas in body for values >=1,000* of table (cm^3)	Text entry
1.05 + 0.02	3,321	Begin first word
0.50 + 0.01	1.2 x 10^7	of each text entry
....		with capital letter.
....		Many text entries
....		have several sen-
....		tences. Do not
....		put a period after
....		final sentence**

Note: General notes like this are placed at the bottom. The first line of each not is indented three spaces. Notes begin with a capital letter and end with a period.

*The asterisk is the symbol for the first footnote (if an asterisk is used in the body of the table in a statistical, chemical, or mathematical sense, omit asterisks from the footnote series and begin the series with a dagger).

Use a dagger for the second footnote; the dagger is on the symbol ball.

Use a section mark (on symbol ball) for the third footnote. Use two leaders (..) to indicate "no data."

**Start the symbol series over, doubling and tripling the symbols if more footnotes are needed.

Appendixes. Title all appendixes (for example. APPENDIX 1. SAMPLE DESCRIPTIONS). Place appendixes at the end of the text before the References Cited.

Mathematical Expressions. Identify mathematical symbols-for example, "lower-case alpha," "upper-case beta," "vector," "zero," "oh," "one," "el." Underline all variables (except vectors) to indicate that they are to be typeset in italics. Define your use of symbols in the text the first time each appears.

Illustrations. All illustrations, whether line drawings or photographs, are classed as figures.

Illustrations (figures) term papers, labs, senior projects, etc.:

a) Prepare clean, clear, reproducible illustrations that are drafted at a size that is readable.

b) **Captions** - Captions **must be** numbered consecutively and **placed below** the figure (do not place captions within the figure margins).

c) **Scales** - Graphic scales should be used on illustrations because verbal scales can be made meaningless by photographic reduction of an illustration for printing. Calibrate graphic scales when used on illustrations in metric (and, if desired, traditional) units. Plan all type sized large enough so that the smallest letters will be at least 4 points (1.5 mm) after reduction.

Illustrations (figures)For publication in a journal - Identify each with the author's name, and number them consecutively. Where necessary, mark "top." Keep the illustrations separate from the text, and include a list of captions, double-spaced, on separate page(s). Do not draft captions within the figure margins.

Prepare clean, clear, reproducible illustrations that are drafted at a size not more than twice the publication size. All lettering on illustrations must be drafted, not typed. For review purposes, copies of illustrations must be legible and relatively easy to handle. do not send original illustrations unless asked to do so.

Graphic scales should be used on illustrations because verbal scales can be made meaningless by photographic reduction of an illustration for printing. Calibrate graphic scales when used on illustrations in metric (and, if desired, traditional) units. Plan all type sized large enough so that the smallest letters will be at least 4 points (1.5 mm) after reduction.

RULES FOR CITING AND LISTING REFERENCES

1) References mentioned in the text, figures, captions, tables, and appendixes must be listed in the References Cited section.

2) Only references cited in the body of the paper are to be listed in the **References Cited** list. References must be arranged alphabetically by author's surname. For references containing two authors, list alphabetically by first author and then alphabetically by second author. For references with more than two authors, list alphabetically by first author and then chronologically, earliest year first. In most cases, spell out journal titles in references. For references that do not match any of the examples given here, write out all information that would help a reader to locate the reference.

3) Citation within the body of your text. You must use the correct style for geology.

Some ex.amples:....

for one article by two authors:	**Adams and Jones (1967) report that ....**
....	.... **(Adams and Jones,1967)**.
for one article more than two authors:	A**dams *et al.* (1967)** studied ....
....	.... **(Adams *et al.*, 1967)**.
for multiple articles:	..... **(Adams, 1966; Brown, 1967b; Adams and Jones, 1967; Adams *et al.*, 1967).**

REFERENCE LIST STYLE (from Geo.Soc.Am.)

ABSTRACT

Booth, M. C., 1978, Carbonate formation in Mars-like environments [abs.]: EOS (American Geophysical Union Transactions), v. 59, p. 110.

Burek, P. J., 1972, The paleogeographic pattern of Europe and North America around the Paleo-Mesozoic boundary and its significance for initial rifting in the North Atlantic: International Geological Congress, 24th, Montreal, Abstracts, p. 256.

Hattin, D. E., 1977, Petrology of the Smoky Hill Chalk Member, Niobbrara Chalk (Upper Cretaceous) in the type area, western Kansas: Geological Society of America Abstracts with Programs, v. 9, p. 603.

BOOK

De Bas, M. J., 1977, Carbonatite-nephelinite volcanism, an African case history: New York, John Wiley & Sons, 347 p.

Press, F., and Siever, R., 1978, Earth (second edition): San Francisco, W. H. Freeman and Company, 649 p.

JOURNAL

Boyer, S. E., and Elliott, D., 1982, Thrust systems: American Association of Petroleum Geologists Bulletin, v. 66, p. 1196-1230.

Godfriaux, I., 1964, Sur le metamorphisme dans le zone pelagonienne orientale (region de, Grece): Societe Geologique de Grance, Bulletin, ser. 7, v. 6, p. 146-162.

Sun, S. S., 1980 Lead isotopic study of young volcanic rocks from mid-ocean ridges, ocean islands and island arcs: Royal Society of London Philosophical Transactions, serv.A,v.297,p. 409-445.

Suneson, N. H., and Lucchitta, I., 1983, Origin of bimodal volcanism, southern Basin and Range Province, west-central Arizona: Geological Society of America Bulletin, v.94,p. 1005-1019.

Comment, Discussion, Reply

Clague, D. A., and Straley, P. F., 1977, Reply *to* Comment *on* 'Petrologic nature of the oceanic Moho': Geology, v. 5, p. 579.

Luyendyk, B. P., and Nichols, J., 1977, Comment *on* 'Petrologic nature of the oceanic Moho': Geology, v. 5, p. 579-579.

Congressional Report or Law

U.S. Congress, Senate Committee on Interior and Insular Affairs. 1949, National resources policy, Hearings: U.S. 81st Congress,

U.S. Inter-Agency Committee on the Arkansas-White-Red River Basins, Mineral and Geology Work Group, 1955, Minerals and geology, Part 2, Section 16, *of* Arkansas-White-Red River Basins Report: U.S. 81st Congress, 2nd session, section 205, Public Law 516.

Guidebook

Cooper, John D., Troxel, Bennie W., and Wright, Lauren A., eds., 1982. Geology of selected areas in the San Bernardino Mountains, western Mojave Desert, and southern Great Basin, California (Geological Society of America Cordilleran Section meeting guidebook, field trip 9): Shoshone, California, Death Valley Publishing Company, 202 p.

Stearns, D. W., 1971, Mechanisms of drape folding in the Wyoming province: Wyoming Geological Association, 23rd Annual Field Conference, Guidebook, p. 125-144.

In Press

Farr, T. G., and Adams, J. B., 1984, Rock coatings in Hawaii: Geological Society of America Bulletin, v. 95 (in press).

Map

Bayley, R. W., and Muehlberger, W. R., compilers, 1968, Basement rock map of the United States, exclusive of Alaska and Hawaii: U.S. Geological Survey, 2 sheets, scale 1:2,500,000.

Mammerickx, J., and Smith, S. M., 1981, Bathymetry of the northeast Pacific: Geological Society of America Map and chart Series MC-43, scale 1:6,442,194 at equator.

Williams, J. R., Pewe, T. L., and Paige, R. A., 1959, Geology of the Fairbanks (d-l) quadrangle, Alaska: U.S. Geological Survey Geologic Quadrangle Map GQ-124, scale 1:63,360.

Zietz, I., Gilbert, F., and Kirby, J. R., 1972, aeromagnetic map of New England: U.S. Geological Survey Open-File Map, scale 1:250,000.

No Author Given

Oil and Gas Journal, 1952, Where are those Gulf Coast salt domes?: v. 51, no. 14, p. 130, 133-134.

Open-File Report

Doe B. R., 1976, Lead isotopic data bank: U.S. Geological Survey Open-File Report 76-201, 104 p.

Paper in a government or university serial publication

Hay, R. L., 1963, Stratigraphy and zeolitic diagenesis of the John Day Formation of Oregon: University of California Publications in Geological Sciences, v. 42, p. 199-262.

Irwin, W. P., 1977, Ophiolitic terranes of California, Oregon, and Nevada, *in* Coleman, R. G., and Irwin, W. P., eds., North American ophiolites: Oregon Department of Geology and Mineral Industries Bulletin 95, p. 75-92.

Phillips, K. N., 1968, Hydrology of Crater, East, and Davis Lakes, Oregon, *with a section on* Chemistry of the lakes, by A. S. Van Denburgh: U.S. Geological Survey Water-Supply Paper 1859-E, p. E1-E60.

Paper in a multiauthor volume

McLaren, D. J., 1982, Frasnian-Famennian extinctions, *in* Silver, L. T., and Schultz, P. H., eds., Geological implications of impacts of large asteroids and comets on the Earth: Geological Society of America Special Paper 190, p. 477-484.

Thayer, T. P., 1967, Chemical and structural relation of ultramafic and feldspathic rocks *in* Alpine intrusive complexes, in Wyllie, P. J., ed., Ultramafic and related rocks: New York, John Wiley, p. 222-239.

Proceedings from a symposium/conference (*include year of conference if it differs from publication year*)

Baar, C., 1972, Creep measured in deep potash mines vs. theoretical prediction, *in* Proceedings, Canadian Rock Mechanics Symposium, 7th, Edmonton: Ottawa, Canada, Department of Energy, Mines and Resources, p. 23-77.

MacLeod, N. S., Walker, G. W., and McKee, E. H., 1976, Geothermal significance of increase in age of upper Cenozoic rhyolitic domes in southeastern Oregon, *in* Proceedings, United Nations Symposium on the Development and Use of geothermal Resources, San Francisco, May 1975, Volume1: Washington, D.C., U.S. Government Printing Office (Lawrence Berkeley Laboratory, University of California), p. 465-474.

Single Paper Published in Separate Parts

Johnson, D.W., 1938 (v. 1), 1939 (v. 2), Origin of submarine canyons: Journal of Geomorphology, v. 1, p. 111-129, 230-243, 324-340: v. 2, p. 42-60, 133-158, 213-236.

Thesis

Saleeby, J. B., 1975, Structure, petrology and geochronology of the Kings-Kaweah mafic-ultramafic belt, southwestern Sierra Nevada foothills, California [Ph.D. thesis]: Santa Barbara, University of California, 286 p.

Treatise - Such as *Treatise on Invertebrate Paleontology*

Hantzschel, W., 1975, Trace Fossils and Problematica (second edition), *in* Teichert, C., ed., Treatise on invertebrate paleontology, Part W, Miscellanea, Supplement 1: Boulder, Colorado, Geological Society of America (and University of Kansas Press), 269 p.

CHECK LIST - SCIENTIFIC WRITING STYLE

FOR **DRAFTS** AND **FINAL COPIES** OF ALL ASSIGNED **PAPERS**, **LAB REPORTS**, AND **SENIOR COMP**

This list is intended to aid you in scientific writing. At minimum, reports (papers) will not be accepted unless you have correctly done items 4, 5, and 6.

______________ 1. **OUTLINE - Only required for comps, lengthy papers or as requested** - Include a complete outline with page numbers listed across from each item in the outline. The outline must clearly demonstrate, by use of indentations and subheadings, your organization. This shows anyone the route you will be taking in your manuscript. (The outline demonstrates how each part of the paper relates to the overall report).

_______ **2. FORMAT OF TEXT** - Organize & logically subdivide the text into **major sections** (e.g., Introduction, Methods, Etc.) **and subsections by use of first-, second-, and third-order (or even 4th order) headings**. The headings are those items in your outline. Position the headings and subheadings, and use capitalization in an appropriate manner-Search for a good example in a professional journal.

3. HAVE YOU MADE A STRONG ATTEMPT TO:

__ **a.** Use **topic sentences** at the beginning of paragraphs throughout the report?

__ **b. Not intermix results and interpretations** while presenting your results? In other words, results must first be introduced and then, later, followed by interpretations.

____**c**. Clearly **demonstrate the basis and/or logic** for your interpretations. (You must show the link (logic) between your data and your interpretation.)

4. CITATION OF LITERATURE - see guidelines in Geoinformation file.

____**a. Within the text** - must use correct style for geology.

Some ex.: for one article by two authors: **Adams and Jones (1967)** report that ....

.... **(Adams and Jones,1967)**.

for one article more than two authors: **Adams *et al.* (1967)** studied ....

.... **(Adams *et al.*, 1967)**.

for multiple articles: ..... **(Adams, 1966; Brown, 1967b; Adams and Jones, 1967; Adams *et al.*, 1967)**.

__ **b. Reference list** - must be a **complete list of all references cited within the text** - use correct scientific style for geology.

__ **c.** The **references cited within the text must match those listed in the bibliography** and vice versa. None missing and no extras.

__ **5. PAGE NUMBERS** - Number the pages (even though they will later change for the drafts).

6. FIGURES, TABLES AND APPENDICES:

__ **a. For all written products** - Supply all figures, tables or appendices referred to in the text. For draft versions of your comp - If the figures are not in final form, at least provide a sketch, description etc. (Be sure to check with your advisor to see if this is o.k.).

__ **b. REFERENCING STYLE** - Be sure that you use the correct style (including capitalization) in your text to refer to figures, tables, and appendices **Ex. ....(Fig.1).**

.................................is illustrated in Figure 1.

.................................(Table 1).

.................................(Appendix 1).

c. CAPTIONS & HEADINGS

__ 1) **Writing** - Be informative (specific) but concise. Be sure to see GSA guidelines and professional journals for further guidance or examples.

______ **2) Placement: captions** along bottom of **FIGURES and headings** on **top** of **TABLES.**

d. LOCATION IN REPORT:

______ **- For draft manuscripts of your comp or relatively short papers (**e.g.,10 p) - Attach the figures, tables, and appendices as a separate section at the end your manuscript. They **must be numbered** (Fig. 1, etc.) and arranged in the sequence in which they are **first referred to** in the text.

_______ - **For final version of your comp** - Place the figures and tables in the body of your paper immediately after the page where you a first refer to the item.They must be numbered and arranged in the sequence in which they are referred to in the text.

7. USE OF NUMBERS IN WRITING.

__ **a.** Do not begin sentences with an unspelled number. Ex.- incorrect - "21 thin sections were....."

__ **b.** Do not mix metric and english units- be consistent.

__ **8. SELF EDITING** - Have you **edited your own work at least twice**? After completing what you envision to be your “final rough draft”, you must then sit back and **carefully rexamine your work for grammar, syntax, and compliance with the above items**

(1 through 7). This final step is most important and can not be overemphasized.

Toward Excellence in Quality of Presentations of Papers Given at GSA Meetings

by Walter D. Keller
University of Missouri - Columbia

Relatively few of the many papers presented at the last GSA Annual Meeting earned an "excellent" rating in an informal, subjective poll. The only qualification required for an excellent rating was simple, realistic, and straightforward, but effectively rigorous: that a new or stimulating idea, which was remembered clearly, was taken away from the presentation by individual listeners. This accords with the original purpose for which GSA was formed: the exchange of geologic information.

A paper rated as "distressed" or "disaster," on the other hand, apparently had adequate technical geologic potential but was presented so ineffectively that listeners took away only a foggy uncertainty about what the speaker really was trying to tell.

It is the purpose of this note, supplementary to H. Edward Clifton's excellent "Tips on Talks" (June 1985 *News & Information*), to analyze how the presentation by the speaker may make one paper a success or another paper a flop, and then to suggest techniques applicable in preparing papers that will be rated excellent.

Put Yourself in the Listener's Place

It is first necessary to determine for whom the paper should be a success. The unequivocal answer is that the real-life appraisers are the listeners - the customers in the learning transaction who are spending their time listening to the product in the hope of taking away something of value. Are there practical psychological and physical communication techniques by which the speaker can make his or her presentation more effective and useful to the listeners? The answer is that there are, as indicated below.

One of the foremost of these techniques is to prepare and present the talk from the psychological viewpoint of the audience, rather than delivering it from the psychological perspective of the speaker. The current buzz term is "to identify psychologically with the listener." The audience, in the role of receptors, typically is listening in a psychologically forward-looking direction to the topic; the minds of the listeners are receptive and resilient. The speaker, the sophisticated leader of the learning session, having worked on the problem for months or years, naturally looks backward at it. Furthermore, the speaker, having met difficulties as well as successes during the investigation, tends to be more sobered and matured than when the research was started. Therefore, to achieve the most productive results with the listeners, the speaker should recapture his or her early attitude of anticipation in investigation. In TV parlance, the speaker should telecast on the wave-length of the listeners, who are enthusiastically forward looking, rather than on his or her own vibrations, which look backward at the problem.

Concentrate on the Main Ideas

Another, equally important, psychological maxim, inviolably applicable to the process of learning from a lecture, is that the learning mind can grasp, assimilate, and retain only a single, main idea during a 15- to 20-minute presentation. An additional supportive idea, if closely allied to the principal one, may also be grasped by the listeners, but more than that likely will be lost and effort wasted (as many experienced teachers have found out the hard way). Therefore, it is the responsibility of the speaker, while preparing the talk, to distill and condense from all the ramifications and "goodies" (in the speaker's memory of the research problem), a single main idea that can be learned and taken away. It is for this acquired idea that the paper and speaker will be remembered. The speaker should spotlight the path for the listeners' minds to follow to the desired destination (idea). To emphasize a concept for your audience, tell 'em in the future tense; tell 'em in the present tense, and tell 'em in the past tense.

Prepare and Practice

Eureka! Now that you, the speaker, have psychologically prepared the Word (à la P.D. Krynine) by which to convert the geological souls of your audience, you are ready to mount the podium. To continue effective communication with your listeners, use the following aids and procedures while making the actual presentation.

1. Rehearse your talks as many times as you will spend in minutes presenting it. You may have said parts of it before, in other talks, but those parts must be assembled and rehearsed for *this* talk.

2. Speak directly into the microphone and look at your audience, not at the floor or ceiling or out of the window. Speak from your diaphragm, following the advice of coaches of public speakers, the same way an opera star sings. That means to project your voice with the column of air in your lungs rather than to masticate and spit out short-raging words impelled only by the tongue, cheeks, lips, and teeth. When projecting slides, speak loudly and very clearly, because your audience is then dependent solely on your voice for communication. By modulating your voice, you can make the presentation more informal, personally appealing, and therefore usually more convincing.

3. When projecting a graph, always identify audibly the information plotted on the axes before diving into the data on the slide. Remember that the listeners have not seen that slide before and must orient their frame of thinking before they can assimilate the data you are presenting. (Here you are working from the viewpoint of the consumer again.) Make your graphs simple; use bold lettering that shows major interpretations rather than comprehensive details.

4. When projecting a summary table of data, first tell the listeners what the subject and purpose of the data are before manipulating the numbers. Note the adjective "summary" in the preceding sentence; the slides presenting data for a talk should summarize the data but not overload the listeners' minds. Those comprehensive tables will be in the later published article; readers can take as much time as they need to analyze and assimilate. Your audience may already be gorged with too many indigestible facts from "distress" papers, so relieve and refresh your listeners with simple interpretative (nontabular), easily assimilable slides and summaries.

5. Although the preparation of special slides and systematizing the mode of presentation best tailored for your audience do, indeed, take much of your valuable time, you, the speaker, owe that much time to the audience. Consider that if you have 100 listeners present at your 20-minute talk, they will spend a total of 33 person-hours listening to you. Therefore it is not too much to expect from a speaker to put in only 4 person-hours, a half day, to prepare an "excellent," rewarding paper.

In summary: present your story from the viewpoint of the audience, speak clearly and audibly, and show simple and clear visual aids. Carefully formulate your main idea and then express that idea so your listeners will take it away in rewarded remembrance of your talk and of you as a speaker.

TIPS ON TALKS
or
HOW TO KEEP AN AUDIENCE ATTENTIVE, ALERT, AND AROUND FOR THE CONCLUSIONS AT A SCIENTIFIC MEETING

by

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"*Breathes there a speaker with soul so dead*
Who never to himself hath said,
As he hears his name from the podium read,
I wish to hell I stayed in bed!"

"First slide, please." The hall lights dimmed, the audience hushed, and the speaker launched into his paper - the culmination of 15 years of painstaking research. An important talk, it included everything he knew on the subject. Flitting from point to point, he realized that he was running out of time and read the paper even faster. He didn't have much time to dwell on his complicated slides, which was unfortunate for they tabulated years of data. By the end of the talk he was going so fast that there wasn't time to reverse the seven slides that were projected backwards. After the chairman finally got the speaker's attention, he closed the talk and stood back for the accolades. The lights came on. Two thirds of the audience had left under the cover of darkness; the other third was asleep.

Our speaker is obviously a caricature - hardly anybody is that bad. But then again, at a recent meeting - well, never mind! The point is that although few speakers do *everything* wrong, even fewer do everything *right*. As a member of the scientific audience, I find far too many talks that are disappointing. Generally, the problem is not due to the quality of the material presented, but rather lies in the quality of the presentation.

The suggestions offered herein are, for the most part, elementary - the sort of thing one would expect every speaker intuitively to know. Yet virtually all are founded on shortcomings I have observed in recently presented papers (some of which, unfortunately, were my own). They deal with three basic elements of a talk: content, organization, and delivery, and conclude with some suggestions on preparation. The viewpoint is primarily that of a member of the audience, but this seem appropriate, for the audience of course is the ultimate critic.

Content

Why give a paper anyway? It is a remarkably inefficient method of disseminating scientific information. A speaker can reach only a handful of potentially interested colleagues, and the time constraints at most meetings rarely permit an extensive exploration of a subject. A talk is an ephemeral event, of which the only lasting elements lie in a brief abstract and the fading memories of the relatively few who attended the session.

Yet oral presentations are a time-honored means of transmitting the fruit of scientific research and scientists will no doubt be speaking at professional meetings for a long time to come. It is a way to reveal quickly our most recent thoughts and discoveries to our colleagues - a way of informing the world that we are into a specific aspect of research (staking out a bit of scientific territory, if you will). It is too often a prerequisite for obtaining funds to attend these meetings, but we won't go into *that*. A scientific talk unquestionably is highly effective for developing fruitful discussion with others interested in the subject. So we will continue to give talks; the question is how do we insure that we give *good* talks.

GSA NEWS & INFORMATION, June 1985

Consider an audience - part of it is there specifically to hear your paper, the rest because they have nothing better to do. It will in most cases be composed of a few people as knowledgeable (or nearly so) as you on your subject, a majority who know at least something about it and many who are totally unfamiliar, or nearly so, with it. A successful talk provides something of value (although not necessarily the same thing) to all these groups.

How does one leave most of an audience with a feeling that they have profited from the talk regardless of the level of knowledge with which they approached the subject? All the memorable talks I have heard, regardless of my familiarity with the subject, shared one common trait: *simplicity*. The speaker convincingly presented a few conclusions, which I retained for a long time. It is more important to get across a few points that will be remembered than to tell *everything* you know about a subject. Better to save the detailed account for the printed text.

Too often speakers waste their precious time at the podium presenting unessential data. Few listeners care for, or will remember, numbers, lists, etc. Of far more interest are significant trends, relationships, or differences - in other words, the *interpretation* of the data.

A speaker must also gauge the background of the prospective audience relative to the topic of the talk. It is well to begin a talk from grounds that nearly everyone will understand. No one, of course, wants to "talk down" to an audience. But sounding condescending is probably more a matter of style than content, and a thoughtful speaker can briefly explain some of the more esoteric terms and concepts without alienating the audience. Terms that are perfectly useful and acceptable within a specialty may be frustratingly mystifying to a larger audience. A listener is distracted by pondering, "Now what does that word mean?," and if too much of the talk hinges on "*that* word" the listener will start to wonder how things are going in that other session across the hall, or at the bar.

Finally, don't build your talk on the assumption that the audience is conversant with the accompanying abstract. More likely, 70 percent have not read it at all, 20 percent have read but can't remember it, and the remaining 10 percent read and remembered it, but are somewhat confused as to what it means.

Organization

A well-conceived talk, carefully tailored to fit audience interest, can still fail if it is difficult to follow.. There is a distinct and important difference between written and oral presentations. A confused reader can regress as needed to wade through an obscure passage; a confused listener is likely to be lost forever. A talk must be carefully organized so that the information flows in a totally logical pattern. There should be no gaps, short circuits, or unnecessary convolutions. When an audience stumbles in making a mental leap, it is the speaker who falls flat. The best structured talks are those where the audience correctly and continuously anticipates what is coming next.

<u>It is well to indicate early in your exposition just where you expect to go</u>. There is merit in the old Army training dictum "Tell 'em what you're gonna tell 'em, ell 'em, then tell 'em what you told 'em." Surprise endings may be dramatic, but they are rarely useful in a scientific paper.

A colleague won the AAPG Matson Award for Best Paper at an Annual Meeting by using the following structure for his talk:

1. <u>A brief introduction</u> that sets the stage and provides perspective on the problem, its importance, the state of knowledge about it, etc. Lights are on here and eye contact is established with the audience. 2. The bulk of the talk, first giving descriptive data and following with <u>the interpretation of this data</u>.

3. <u>A few</u> (four or five) <u>conclusions</u>, one of which points out the significance of the material presented. Lights are again on here to permit eye contact with the audience.

This format may not guarantee you the Matson Award, but it will assure that your overall organization is simple and coherent. Note, incidentally, how simplicity in content facilitates smooth organization.

The coordination of text and slides is highly important. A talk offers a far greater potential for integrating illustration than does a written paper, but many speakers never fully utilize this potential. A well-conceived slide quickly and wordlessly projects the speaker's point.

A speaker should not assume, however, that the audience intuitively grasps a slide's meaning; but rather one should succinctly point out the salient features of the slide, especially indicating the physical meaning of nonstandard mathematical phrases or symbols.

The number of slides that can be shown in a talk depends primarily on their complexity. Having too many slides creates confusion and obviously should be avoided. Having too few slides poses a different problem: the speaker must turn the lights off and on (which can be disruptive) or leave the room totally dark (which can be soporific), or leave in the last slide while continuing to talk about unrelated subject matter (which can be both distracting and confusing). It is better, I think, to illustrate virtually every point in a talk with a different slide. This approach not only serves to hold audience attention but also provides the notes or reminders from which a talk is given. Of course, slides that appear only for brief periods must quickly convey their message. As a matter of principle, I prefer to see a series of similar slides, each focusing on a separate aspect., than a single complicated slide that requires much explanation.

One excellent way of coordinating slides is to show two of them simultaneously on separate screens, an option offered with increasing frequency at major meetings. One slide can serve as a reference, such as a location map, stratigraphic section, or panoramic view, that provides perspective for a series of slides on the other screen. The use of two screens demands that the instructions to the projectionist be absolutely
clear, in the format standard for that particular meeting (a good practice in *any* event).

Delivery

Of the three elements of a scientific talk, delivery is probably least important. A well-conceived, logically organized paper will to some degree survive the dullest presentation, whereas the most articulate delivery cannot salvage a talk that misses audience interest or one that cannot be followed. This is not meant to imply, however, that delivery can or should be neglected; a poorly delivered talk is unlikely to be well-received. Even though delivery is, to a degree, frosting on the cake, it can, like frosting, get attention and make the whole thing more palatable.

Reading a paper from a prepared text may be the easiest way to deliver it for many people - but it almost certainly is the most difficult way of delivering it *well*. I think that papers are most often read because of insecurity - the speaker is afraid he will lose his place, omit some important point, or perhaps does not trust his ability to sound learned before his colleagues. All of these concerns are generally invalid. No speaker with good notes (or better yet, carefully organized slides) will get significantly lost during his talk. Really Important Points are rarely forgotten by a well-prepared speaker during a presentation, and those that are will either be raised during the discussion following the talk or never missed. Perhaps the best thing that could happen to readers of talks is for a vagrant breeze to carry their text out the window seconds before they ascend the podium. After the initial panic subsides, nearly all would sail through their talk with little difficulty. Their presentation would likely be far more effective and they would recognize a written text for the crutch it is.

How does one deliver a paper without reading it? Basically, by thoroughly knowing the subject. All of us can clearly explain our slides informally to a small group of friendly colleagues. The same style of exposition works nicely before a larger (and potentially less friendly) audience.

Audiences almost always give a speaker the benefit of the doubt. Usually, at worst they are merely polite. I have never seen a speaker bodily assaulted at an SEPM meeting, although some of my colleagues have.

The process of referring to slides during a talk can pose special problems. It is too easy to turn from the audience (or microphone), and have one's voice diminished to an inaudible mumble. Some speakers, forgetting to release the switch on a flashlight pointer, splash the beam about the wall and ceiling in a fascinating display that is potentially more interesting than the talk itself. Small nervous tremors in the speaker's hand are amplified in the pointer's spot on the screen and betray a shakiness that most of us would prefer to hide.

Many of these problems are obviated by having a colleague or co-author employ the pointer from the front row of the audience. Such a confederate *must* be totally familiar with the talk. Occasionally a pointer from the floor gets disconcertingly out of phase with the speaker. Regardless of who handles the pointer, it is probably best used sparingly, spotting key points on the slide and otherwise kept off. Holding a flashlight pointer with both hands or in the crook of the arm will help to steady it and salvage that image of comfortable composure regardless of how unsteady the knees are.

Tips on Talks

Stage fright in one form or another is probably universal. Who has now known a shallowness of breath, a racing pulse, or sweaty palms before mounting the stage? Slow, deep breathing superimposed upon a concentrated effort to relax the body's muscles will greatly reduce these symptoms. The knowledge that you have thoroughly prepared for a talk adds much confidence. Experience is probably the best teacher. I know that my stage fright will largely dissipate once I begin talking, and nightmares to the contrary, all appropriate zippers *will* be closed and I will not, part way through my talk, abruptly switch to a recitation of "Mary had a little lamb."

Preparation

The obvious key to a successful scientific talk is adequate preparation. The number of speakers who seem to be ill-prepared is therefore surprising. Perhaps part of the problem results from the predictable situation whereby a speaker, having gained experience, requires progressively less time for preparation. Unfortunately, this last phrase can also be translated "gets by with less and less preparation," and the speaker who falls into this trap will ultimately be caught with a substandard effort. Probably every experienced speaker skirts this pitfall and some of us fall into it. Over-confidence is a common reason, but a poor excuse, for inadequate preparation.

Preparation consists of two parts: composing the talk and rehearsal. The first part is probably the more important, but it is also easier to slight. The skillful speaker begins planning well in advance of the presentation. The level of audience interest and background is assessed, and the content of the talk accordingly determined. The talk is ordered into a sequence of flowing logic. Slides are conceived to convey their message quickly and directly and knit tightly into the fabric of the talk. If all these things are done well, the speaker is almost assured of some success.

Rehearsal is both valuable and necessary. It is valuable in that it allows the speaker to develop a smooth delivery by incorporating key words and phrases; valuable because it offers a means of checking content and organization before a group of friends prior to the presentation. It is necessary because it is almost the only way to establish timing. Even if the paper is (God forbid!) read, rehearsal is vital to staying within the time frame. I know speakers who, preferring an informal delivery, eschew rehearsal. They are also the ones most likely to get caught in the "Migawd!-it's-the-two-minute-warning-and-I'm-only-half-way-through" panic. Observing a speaker thus trapped can be entertaining, but it doesn't do much for the communication of scientific information.

It does not pay, however, to attempt to memorize a paper word for word. A paper obviously presented by rote sounds stilted and unnatural and is as distracting as one that is read.

A last feature of preparation is so elementary that it scarcely seems worth consideration; yet, by ignoring it, many speakers run into trouble. Virtually every meeting has talks that are marred by slides that are out of order or disoriented. I've noticed that the audience laughs at the first upside-down slide, mutters at the second, and begins to leave at the third. This and other projection problems are easily obviated by arriving at a session early and asking the projectionist to run the slides through the projector. (It helps to bring your own loaded slide carrier.) Projectionists always seem eager to comply with such a request (they don't like fouled up slides any more than speakers do). It gives you a chance to insure that your instructions to the projectionist are clearly understood, and also provides a chance to critique your slides from an audience's viewpoint, incorporating any last-minute clarifications that might seem appropriate. Finally, I like to stand on the podium prior to a talk and check out microphones, slide control buttons, and the pointer; that way, it seems less strange when I ascend the podium in earnest.

Summary

If I had to express the points of this paper in a single sentence, it would be "Never force an audience to think for itself." This can be accomplished in a variety of ways:

1. Keep the content of the talk simple, containing only major points.
2. Be sure the audience understands all of your terminology.
3. Have the talk simply arranged in a logical sequence.
4. Use simple slides.
5. Avoid distractions.
6. Know your talk well.

There are substantial differences between a spoken and a written paper. The wise speaker recognizes these differences and programs a talk accordingly. The focus should be on the audience-its interests, its level of knowledge of the subject, its ability to assimilate the information. Just as beauty is in the eye of the beholder, success in a scientific talk is in the mind of the audience. The speaker who deliberately caters to the audience is almost certain to keep them interested, alert, and present when the lights come on, convinced that they have heard, finally, a *good talk*.

Acknowledgements

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GUIDANCE FOR READING A SCIENTIFIC PAPER

It is impossible for anyone get much out of a paper by means of one casual reading. Moreover, it is difficult and very inefficient to plow, "hardcore", through a paper in a single time-sequence manner (even if the "sequence" involves a number of sittings). Your brain has to first get a feel for the topic, content, and organization. The following will actually save you time, increase your reading effectiveness, and result in greater understanding.

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1) First "survey" the paper:

a. Read the **title and author**.

b. Quickly read the **abstract & introduction** to get a feel of what the paper is about. Push your way through it, don't get bogged down.

c. Now, just turn pages and notice (read) the **major headings and subheadings**. Take enough time to see how each set of subheadings fit under (in context of) the higher-level headings. The **headings/subheadings show the organization of the paper and serve to inform you of the author's topics and the "route" that will be taken**. You may also wish to survey some introductory paragraphs under the headings and some topic sentences.

d. In a similar manner, casually examine the **nature and sequence of figures, tables,** etc.

e. Quickly **survey the discussion and/or conclusions**. Pay attention to topic sentences. (see item 2 below.)

2) Now read the paper in earnest. As you read the paper, pay careful attention to topic sentences. There should be a good topic sentence at the beginning of each paragraph. Sometimes a first paragraph serves as a "topic paragraph". I may ask you to identify some excellent topic sentences in class as well as what you think are some poorly written sentences (topic or otherwise).

3) At minimum, when you have finished slowly reading the paper (***which translates to careful slow reading, usually at least "twice over" for many sentences & paragraphs plus careful examination of most figures***) you should know the following:

a. Title & author.
b. Location of study area.
c. Purpose of the research project, or, purpose of the article if it is not an original investigation (such as, a synthesis or review).
d. Methodology - especially if an special or unusual technique is used to address a question in an innovative manner.
e. Principal findings & conclusions.

4) You may wish to create a set of notes for the various items in #3 (above) rather than attempt to memorize it for class. Then you can simply access your notes when asked about the items. For any paper that I assign for class discussion ***we will select and discuss key parts of the assigned articles***. ***I will be asking for your explanations, interpretations, and comments.*** In order to successively deal with this, you will have to carefully read & attempt to understand the assigned material.