A TECHNICAL WRITING PRIMER

By Geology Alumni Advisory Board - Principal Author: David Muscalo CPG

Prepared For: Undergraduate and Graduate Geology Students
University of Buffalo

PURPOSE

When the author completed his Master's program at UB, he mistakenly assumed that he was a competent technical writer. After all, he had received a high-quality education in Geology and related fields including Mathematics. He had cobbled together, with the considerable help and patience from his thesis advisor, a paper of sufficient quality to be defendable.

After entering the geological consulting business where his principal responsibilities initially involved geological engineering projects, he worked closely with other geologists and engineers. He soon learned that the quickest way to advance up the corporate ladder was through good technical-writing skills. Unfortunately, he was woefully lacking in these skills and only acquired them over several years through extensive reading and mentoring from other professionals.

This primer is prepared to shorten that process for others. It is not exhaustive but will provide you with methods for developing the basic skills needed to prepare a lucid, informative report that can be read with speed and rapid cognition.

As the author of a technical report, remember, you are a reporter who is conveying information to others. That information needs to be presented in a manner that the reader can comprehend and use to make informed decisions.

TABLE OF CONTENTS

1.0 FIRST STEP

If you were writing a letter to your best friend, you wouldn't use the same vocabulary, sentence structure and tense as you would if you were writing to a prospective employer. The same is true for a technical writer: a technical report written for the president of a corporation should not be prepared and presented in the same manner as an academic report.

In other words, the **first step** in preparing a technical report is to **identify the needs and technical competence of the reader**.

Why does the reader need the report? Is he or she a professor who is interested determining your understanding of the subject matter, or is the reader a regulator who needs to know if your client's property is in compliance with a specific set of regulations? These questions need to be answered first, because no matter how thoroughly your research has been conducted and the data vetted, if they are not presented in a manner that the reader can understand, your work has been in vain.

2.0 PREPARATION

Once you have identified and determined the needs of the reader, you have the object of the report clearly defined. Before you begin writing, however, you need to collect background information and prepare the necessary visual elements around which the report is to be written. This information may include:

- **Figures**, i.e. geologic maps, site maps, topographic maps, ground-water contour maps, isoconcentration maps, hydrographs, rose diagrams, stereoscopic projections, etc.
- **Tables**, i.e. analytical tables, physical characteristic tables (well specifications), statistical tables, etc.
- **Photographs**, i.e. rock structures (ripple marks, mud cracks, faults, joints, rock contacts, fossils etc.), site photographs, investigative apparatuses, subcontractor operations, contamination evidence, etc.
- **Field notes**
- **Historical Maps**
- **Legal information**, i.e. permits, permission forms, deeds, environmental violations, mineral rights documents, water-use rights documents, building permits, etc.
- **Field data**, i.e., boring logs, well logs, geophysical survey data/reports, sketches, water-level data, etc.

From these information sources, the writer should organize a sequential presentation which begins by providing the reader with background information and proceeds through the data collection processes into the data analysis processes from which conclusions are formulated succinctly and lucidly presented.

3.0 ORGANIZATION

Perhaps the easiest way to organize your thoughts before beginning to write a report, or any document for that matter, is to prepare a **table of contents**. You already have at least a rough idea of what you would like the report to say. The table of contents will aid in organizing – in a structured manner – the order in which these thoughts will be presented.

Below is a possible table of contents for a report prepared for a Phase I Environmental Site Investigation. The site is an automobile repairs shop.

TABLE OF CONTENTS or CONTENTS

FIGURES

TABLES

LIST OF PLATES *(photographs)*

APPENDICIES

Below is a possible table of contents for a report prepared for a professional paper or a Masters/Doctorate Thesis. The title of the report is Holocene Faulting, San Bernardino Valley Area, San Bernardino County, California.

TABLE OF CONTENTS or CONTENTS

LIST OF FIGURES

WORKSHEET 1

*Select a recent project you have been involved with and prepare a **table of contents** from which a report will be prepared. (The topic does not have to have been broad in scope or as detailed as those presented above.)*

4.0 PRESENTATION

Now it is time to write the report, but before we begin writing we need to think about some of the grammatical and syntactical elements that need to be considered if the report is to be easy to read and comprehend.

4.1 Grammar/Syntax

Voice - In general, scientists are careful to avoid overly dogmatic or inflexible language when writing reports. We, therefore, often unconsciously use the *passive voice* when the *active voice* would be more appropriate. Of the two voices, the passive voice is weaker. In the active voice, the subject acts on the object. In the passive voice the object acts on the subject.

EXAMPLE:

Active Voice (*preferred)* - The geologist used his Brunton® compass to measure the strike and dip of the sandstone outcrop's bedding.

Passive Voice - The strike and dip of the sandstone outcrop's bedding were measured by the geologist.

Sentence Length - For the most part, short sentences are preferred. One thought per sentence is the general rule.

EXAMPLE:

Single Thought (*preferred)* - The seismic survey was completed on the landfill within the projected three-day window. The ground-water monitoring program was not completed within the projected four-day window.

Two Thoughts - The seismic survey was completed on the landfill within the projected three-day window, but the ground-water monitoring program was not completed within the projected four-day window.

Modifiers - Modifiers are useful in creative writing where amplification, exaggeration and qualification are sometimes desirable. In technical writing, modifiers should be used infrequently and with caution.

EXAMPLE:

With Inappropriate Modifiers: The **very large** (*size indefinite*) boulder located left of center in the photograph is a **glacial** erratic (*redundant, erratics are glacial in origin*) composed of granite.

With Appropriate Modifiers: The 1.4-meter diameter (*describes size*) boulder located left of center in the photograph is an erratic composed of muscovite-orthoclase(*further describes the rock type*) granite.

With Inappropriate Modifiers: The soft, suffuse rays of the setting Sun produced eerie shadows on the precariously positioned basalt outcrops soaring skyward above the talus slope. (*This sentence may sound poetic, but it does not belong in a technical report*).

With Appropriate Modifiers: Under low-light conditions the columnar-jointed basalt outcrop casts shadows onto its talus slope making the surface of loosely fitting rock fragments more dangerous than when lighted by full daylight.

4.2 Spelling

The writer is a poor speller. The writer knows he is a poor speller. One of the most commonly misspelled words in the English language is misspell. Fortunately for poor spellers such as I, there is Spell Check® for Microsoft Word. But Spell Check® is not foolproof. For instance, it does not recognize the grammatical difference between their and there or vane, vein and vain.

Additionally, the Spell Check® database lacks many of the technical terms we scientists use, such as, hydrogeologist. You have to add them to its dictionary. In some instances, Spell Check® recognizes the noun form of the word but not other forms of the same word. For example, species, but not speciate.

Avoid foreign English spelling of words:

EXAMPLE: An irritating (to me) example is ground water. This term is commonly and incorrectly spelled *groundwater*. Groundwater is the correct spelling in England and Canada. The United States Geological Survey publications use ground water as do professional publications such as Ground Water, the technical journal of the National Ground Water Association.

Other descriptive words such as *colour* should not be used. The use of *-our* rather than *-or* is a holdover from the French word which was adopted into the English language after the Norman conquest of England in 1066.

4.3 Composition - Do's and Don'ts

Words To Avoid - In general, jargon should be avoided. Jargon is the use of technical terms and complex words when simpler common words will convey the message. Jargon is permissible or preferred when the report will be read by peers and is not for consumption by the general public.

EXAMPLE:

Jargon: Utilizing ground-penetrating radar, electroconductivity, resistivity and other geophysical methods that (*there is nothing wrong with the word that, which gets used too often, when that will do*) allows us to determine the depth to the top of rock and the water table without having to use more expensive methods, such as, drilling or excavating.

Better: Using (*using is more rapidly understood by the reader than utilizing*) geophysical methods (*describe each of the methods later and separately carefully explaining their applications*) allows us to determine the depth to top of rock and the water table without having to use more expensive methods, such as drilling or excavating.

Connectives: Conjunctions used to join sentences should be avoided. Words, such as, and, but, etc.

EXAMPLE:

Compound Sentence: The driller installed fourteen monitor wells on the 7-acre tract using auger-drilling methods, and he completed each well with a locking cap to prevent unauthorized access. (*The reader is required to assimilate two disparate thoughts, thereby, slowing comprehension.)*

Better: The driller installed fourteen monitor wells on the 7-acre tract using auger-drilling methods. He completed each well with a locking cap to prevent unauthorized access. (*Speed of comprehension is increased.)*

Introductory Adjectives: Words, such as, moreover, consequently, subsequently, also etc.

EXAMPLE: The mapping project provided the necessary data for developing a plan designed to stabilize the north slope of Mount Tor. Additionally, these data (*The word data is the plural form of datum.)* provide lithologic and structural information that was previously unknown.

Better: The mapping project provided the necessary data for developing a plan designed to stabilize the north slope of Mount Tor. These data provide lithologic and structural information that was previously unknown.

Nonspecific Words: Words such as any, some, few, etc.

A partial list of words to avoid is contained in **Appendix A**.

4.4 Punctuation

The use of commas, parentheses, quotation marks and periods is straightforward, but the use of colons, dashes, hyphens and particularly semicolons can be problematic. In general, **colons** are used: to punctuate the salutation in a business letter; to introduce long formal statements; between main clauses when the second clause explains the first; between numbers when writing time; between volume and number or volume and page when referencing a periodical, and to introduce a list of items.

EXAMPLES:

1. Dear Mr. Johnson:

2. The Principle of Superposition had far reaching philosophical as well as scientific significance when it was first proposed: It provided geologists with a means of using the relative position of distinct rock units for the purpose of determining which unit was the oldest and which unit was the youngest.

3. The geophysical equipment is stored in the locker located in the basement of Hobart Hall: resistivity transmitter and receiver, electroconductivity transmitter and receiver, seismic geophones and data logger, proton-magnetometer-data recorder and ground-penetrating-radar transmitter (sled) and receiver.

4. 10:00 AM; Ground Water 10:123 or 10:25-33.

5. The following field equipment will be needed:

   Steel-toed boots
   Brunton® compass
   Rock Hammer
   Waterproof field notebook
   Light-colored, loose-fitting clothing
   Insect repellent
   Water bottle
   Pocket knife

The hyphen is used for: compound numbers from twenty-one to ninety-nine; compound adjectives (when one of the modifying words is an adverb ending in ly, omit the hyphen); all prefixes before proper nouns and with prefixes ex, self, and all; preventing confusion or awkward spelling, and fractions when they are used before the words they modify.

EXAMPLES:

The field party consisted of *twenty-seven* geology students, seven faculty and three cooks.

The petrologist used a petrographic microscope to confirm that the rock sample collected from the Saylor Creek Formation is a *biotite-orthoclase-quartz* granite.

Her workload of 21 credits per semester was *self-imposed*, but it permitted her to graduate in three years rather than the customary four years.

The *ex-Geology* Department chairman was present at the graduation ceremony.

To save money, the field crew *re-used* their water bottles by refilling with spring water.

When *two-thirds* of the available drawdown in the test well was exhausted, the hydrogeologist terminated the pumping test.

Numbers: Generally, in technical writing, numbers below 10 are written out; those above ten are expressed numerically. Exception to this rule is made when a number begins a sentence.

EXAMPLES:

There are *seven* crystal systems and *32* crystal classes.

Twenty-seven tons of gold-rich ore were mined from Stope Five today.

When in doubt, consult one of the suggested references contained in Section 9.

WORKSHEET 2

Prepare a report based on your table of contents (Worksheet 1)

5.0 REFERENCES

This section should be reflective of the documents used for scientific research issues, regulatory issues, statistical issues and other issues germane to your report. Articles that may have been reviewed, but from which little or no information is included in your report, should be omitted.

EXAMPLE:

REFERENCES

Advocate Environmental Consulting, Inc., Remedial Action Progress Report, October 2003, Lafayette, New Jersey, 46p.

BELL Environmental Consultants, Inc, Remedial Investigation Report, June 2003, Budd Lake, New Jersey, 24p.

Drake, A. A., Volkert, R.A., Monteverde, D. H., Herman, G.C., Houghton, H.F., Parker, R.A. and Dalton, R. F. 1996. Bedrock Geologic Map of Northern New Jersey, New Jersey Geological Survey, Trenton, New Jersey.

Fetter, W. C., Applied Hydrology, 1989, McMillan Publishing Company, New York, 592 p.

Fetter, W. C., Contaminant Hydrogeology, 1993, McMillan Publishing Company, New York, p. 306.

Field Sampling Procedures Manual, August 2005, New Jersey Department of Environmental Protection, Trenton, New Jersey.

Howard, H.H., Boethling, R.S., Jarvis, Meylan, W.F. and Michanlenko, E.M., Handbook of Environmental Degradation Rates, 1991, CRC Press, New York.

New Jersey Department of Environmental Protection, 1994, Guidance Document for the Remediation of Contaminated Soils, Trenton, New Jersey, 67p.

Nemikas, Bronius, Bedrock Topography and Thickness of Pleistocene Deposits In Union County and Adjacent Areas, New Jersey, 1974, U. S. Geological Survey, Washington, D.C.

Hydrotechnology Consultants, Inc., 1999, Results of Investigative and Remedial Activities, Hoboken, New Jersey, 15p.

New Jersey Administrative Code. 1997. Chapters 1, 14B and 26E.

Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (Designation E 1739-95), 1995, American Standards Testing Materials Society, West Conshohocken, Pennsylvania, 51 p.

United States Geologic Survey, photorevised 1981, Chatham, New Jersey Quadrangle.

WORKSHEET 3

List your references.

6.0 ABSTRACT OR EXECUTIVE SUMMARY

An ***abstract*** can be defined as: a summary of a text, scientific article, document or speech. For our purposes, an abstract is a condensed account of a scientific article.

An ***executive summary*** can be defined as: a condensed account of a technical report prepared for a client or a government agency.

For both abstracts and executive summaries, the information contained in the entire report is condensed such that the tables, maps and other supporting documents are omitted but conclusions drawn from information contained on them are included. The entire body of pertinent information is included in abstracts and executive summaries.

The author has found that one can expeditiously prepare an abstract or executive summary by copying, verbatim, the entire article, removing the section and subsection headings, tables, maps, drawings and footnotes. The text can then be modified to exclude references to the deleted visual information. Examples of each summary are presented:

EXAMPLE 1 - ABSTRACT

Abstract

The New Jersey Department of Environmental Protection's Technical Regulations require the horizontal and vertical delineation of contamination. Monitor wells screened at increasingly deeper intervals are used to delineate vertical contamination. In New Jersey, the open interval in a bedrock well cannot exceed 7.6 m. Since contamination has been found at depths as great as 91.4 m in a production well in the study area, it would be prohibitively expensive to install monitor wells with 7.6 m open holes at ever-increasing depths until no contamination was found. Isolation of discrete zones in boreholes using pneumatic packers was implemented at a site in north central New Jersey. Ground-water samples were collected from selected 6.1 m sections of boreholes drilled into fractured bedrock at three locations on the property and one offsite location. The ground-water samples were analyzed in a field laboratory. The analytical results were used to determine the vertical extent of gasoline-related compounds dissolved in the ground water on the property and offsite. These compounds include benzene, ethylbenzene, methyl tertiary butyl ether, toluene, and xylenes. The four boreholes were converted into bedrock monitor wells. The intake interval for each of the wells was selected through evaluation of the vertical distribution of contaminants as determined from analytical results obtained from a field laboratory located onsite. Three wells are used for the recovery of contaminated ground water. The recovered water is treated at the onsite air-stripping unit. The fourth well is used to chemically and hydraulically monitor the progress of the ground-water-recovery program.

EXAMPLE 2 - EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

CCI is located at 250 Jackson Street, Englewood, Bergen County, New Jersey. CCI is located in a mixed commercial/residential area. D&C Enterprises is located immediately to the south of CCI. Home Fuel Oil

Company is located to the east of CCI (on the east side of Jackson Street). Republic Lens Company, Inc. is located to the north of CCI (on the north side of Columbus Avenue). A warehouse is located to the west of CCI. The property is identified on the Bergen County Tax Maps as Block 2506, Lot 1. The latitude and longitude of CCI is 40º 53' 12.0" N and 73º 58" 54.4" W, respectively.

CCI is a meat-processing and meat-packaging facility. The property is comprised of a 0.5-acre lot. The lot contains one, one-story building constructed of cement blocks in 1972. The remaining portion of the property is paved with asphalt for parking. The sanitary sewer line, gas line, water-supply line and electrical line enter the building from the subsurface near the northwest corner of the property. The telephone utility lines are above ground.

The CCI fleet of delivery trucks formerly obtained fuel from two, 2,000-gallon diesel-oil containing underground storage tanks (USTs) and a dispensing island.

In May 1997, CCI submitted an application to the Department of Environmental Protection (NJDEP) Bureau of Underground Storage Tanks for approval to close two, 2,000-gallon diesel-fuel oil containing USTs. On June 24, 1997, the NJDEP issued the closure approval document.

On July 11, and July 12, 1997, the two USTs were closed. Closure activities included:

- Removal and off site disposal of about 1,500 gallons of fuel and ground water;

- Cleaning and removal of two, 2,000-gallon diesel-oil-fuel containing USTs, associated piping and pump island for off site disposal.

During closure, the USTs were found to contain corrosion holes and holidays. Visual and olfactory signs of soil contamination are reported. It is reported, the licensed subsurface investigator collected post-excavation soil samples from the USTs' excavation sidewalls in accordance with N.J.A.C. 7:26E.

From October 15 through October 17, 1997, the contractor removed about 275 tons of soil containing diesel fuel from an excavation measuring 28-feet long by 23-feet wide by seven-feet deep. Additionally, the contractor pumped 2,300 gallons of ground water containing diesel oil from the bottom of the excavation. It is reported that the contractor disposed of the soils and ground water at a licensed facility. Post-excavation sampling results indicated that diesel-oil impacted soils remained to the south of the excavation. On November 10 and November 11, 1997, the contractor removed about 75 tons of fuel-oil containing soils from the adjacent property owned by D&C Fuel service at 256 Jackson Street. Additionally, the contractor removed about 500 gallons of ground water containing diesel oil. It is reported that the contractor disposed of the soils and ground water at a licensed facility. Post-excavation sampling results indicated that a clean zone had been delineated at the perimeter of the excavation. Soil samples SS-1 and SS-3 through SS-8 contained concentrations of total petroleum hydrocarbon compounds (TPHCs) above NJDEP soil cleanup standards. The excavations were deepened at these locations to seven feet below ground surface where field screening results indicated remaining soil was free of contamination.

On January 12, 1998, a licensed well driller installed a monitor well (MW-1). In March 1998, the contractor collected a ground-water sample from MW-1. It is reported that a New Jersey certified laboratory analyzed the water sample for volatile organic compounds (VOCs), base/neutral compounds (BNCs) and lead. The sample was found to contain a concentration of benzene at 25 µg/l. This concentration exceeds the NJDEP Ground Water Quality Cleanup Standard (GWQCS) for Class IIA aquifers of 1µg/l. No concentrations of lead or BNCs that exceeded NJDEP GWQCS for Class IIA aquifers were reported to be present in the ground-water sample.

Since the ground water on CCI was found to contain concentrations of benzene above NJDEP GWQCS for Class IIA aquifers, it was necessary (in accordance with N.J.A.C. 7:26E) to install three additional monitor wells to delineate the extent of ground water containing concentrations of benzene above ground water cleanup standards. On August 5, 1998, a licensed well driller installed three additional monitor wells.

On August 25, 1998, it is reported that a technician collected ground-water samples from the four monitor wells in accordance with the 1992 edition of the NJDEP's Field Sampling Procedures Manual. Five compounds (benzene, cis-1,2-dichloroethene, 1,1-dichloroethane, MTBE and toluene) were found in the ground-water samples. The concentrations of benzene in MW-2 (36 µg/l) and MW-3 (16 µg/l) were above NJDEP GWQCS for Class IIA aquifers. Additionally, the concentration of TICs (650 µg/l) in the ground-water sample collected from MW-3 exceeded NJDEP GWQCS for Class IIA aquifers.

The contractor analyzed the ground-water-elevation data reported for August 25, 1998 and concluded that ground water flows across CCI from east to west. MW-2 is located hydraulically downgradient of the former excavation and MW-3 is located hydraulically upgradient of the former excavation. These concentrations were likely derived from diesel fuel compounds remaining in the soil near these wells. They were residual and will likely dissipate with time.

Since MTBE is not used to formulate diesel fuel, it is likely that the concentrations of MTBE found in the monitor wells on CCI is derived from a hydraulically upgradient source. Concentrations of MTBE were reported for the two ground-water samples collected from the upgradient wells MW-3 and MW-4.

Since the cis-1,2-dichloroethene and 1,1-dichloroethane are daughter products of solvents and are not diesel fuel constituents, it is likely that the concentrations of these compounds reported in the ground water samples collected from MW-3 and MW-4 are derived from a source that is located hydraulically upgradient of CCI.

The March 2002 Remedial Action Progress Report for the ground-water investigation conducted on CCI concluded that based on the ground-water sampling results, CCI has selected natural attenuation as a remedial action. The Classification Exception Area (CEA) that addresses the natural attenuation of benzene concentrations dissolved in the ground water on CCI was proposed at that time. Ground-water sampling results from March 10, 2004 demonstrate that benzene concentrations have naturally attenuated to below NJDEP cleanup standards.

WORKSHEET 4

Prepare an abstract.

7.0 ACKNOWLEDGMENTS

Acknowledgments should appear at the end of a professional paper. The author's peer reviewers and other contributors to the article should be cited in the acknowledgments section. Additionally, regulatory personnel and subcontractors, i.e. laboratories, drilling firms, materials suppliers and other contributors to the project should be cited.

EXAMPLE:

Acknowledgments

The cooperation and helpful suggestions of NJDEP representative Joseph P. Eaker significantly contributed to the successful completion of this project. The workmanlike competence and teamwork of the drilling and packer sampling crews from Summit Drilling Company, Bridgewater New Jersey, are appreciated. The field laboratory operator, Timothy S. Gallagher of Enviroprobe Service Inc., Westmont, New Jersey, provided analytical results from which field decisions were made. The helpful comments on the manuscript from Richard Werner of Environmental Consulting Inc., Norristown, Pennsylvania, are appreciated. The author is particularly indebted to NGWA reviewers Frank Beck Jr., U.S. EPA, Ada, Oklahoma, and Charles T. Kufs, Willow Grove, Pennsylvania, for their thorough critiques of the original manuscript.

WORKSHEET 5

Prepare an acknowledgments statement

8.0 PEER REVIEW

I have yet to meet anyone who can review their own work objectively enough to find all the typographic errors, and, in some instances, technical errors that *all* draft reports contain. The author who has just written the report knows what it is supposed to say, and, as such, he or she often does not see the typos, omissions and contradictory statements. The longer the report sits after it is completed, the better review it will get from its author. However, most documents need to be reviewed within hours or a few days after they are written; therefore, the reviewer(s) should not be the author.

A *peer reviewer* should be someone of equivalent education and training in the same field or closely related field as the author. Peer review is one instance where too many cooks do not spoil the soup. While employed as an Associate in a large environmental consulting firm, I was the fifth and last person to review reports before they were submitted to clients. Even though four other technical reviews had previously vetted the reports, I would find typos and often technical errors. It is nearly impossible to produce a typo-free document and that is why a disclaimer statement is included in most reports submitted to regulators and commercial clients.

The following is an example of a disclaimer:

DISCLAIMER

The information contained herein is accurate to best of our knowledge and belief; however, Advocate Environmental Consulting, Inc. can not guarantee as to its accuracy, completeness, and validity. Furthermore, Advocate Environmental Consulting, Inc. can not be held liable for any errors or omissions. Advocate Environmental Consulting, Inc. does not accept any liability for any loss or damage howsoever caused in reliance upon such information.

Trademarks and copyrights mentioned with this report are the ownership of their respective companies. No endorsement of any third-party products or services is expressed or implied by any information, material or content referred to in this report.

WORKSHEET 6

Ask one or more of your colleagues to provide a critical review of your report.

Add a disclaimer statement to your report.

Print and assemble your report.

9.0 SELECTED REFERENCES

The reference list is by no means exhaustive, nor is it intended to be so.

The author's primary reference is: Suggestions to Authors of the Reports of the United States Geological Survey, Fifth Edition, 1958.

Another excellent resource for style, presentation syntax and content is: The Chicago Manual of Style, 13th Edition, 1982.

The most authoritative and scholarly dictionary is: The Random House Dictionary of the English Language, Second Edition Unabridged, 1987.

A concise but thorough grammar primer is: English Grammar and Composition COMPLETE COURSE, 1957, John E. Warner and Francis Griffith, Harcourt, Brace & World, Inc., New York, 692p.

Another source for improving writing skills is: Powerful Writing Skills, 2001, Richard Anderson, Fall River Press, New York, 125p.

Another grammar reference is: The Elements of Grammar: The Essential Guide to Refining and Improving Grammar, 2001, Margaret Shertzer, Fall River Press, New York, 168p.

APPENDIX A

WORDS TO AVOID/MINIMIZE IN TECHNICAL REPORTS

about
abundant
accordingly
across
actually
additionally
aforementioned
all
around
always
altogether
and (when used to connect independent clauses)
any

believe
but
better

certainly
considerably
consequently

definitely

enough
ever
every
everywhere

few
frequently
furthermore

great
groundwater

hence
henceforth
herein
heretofore
herewith
however
huge

immediately (unless defined)
immense
indeed

large

many
maybe
mere (merely)
moreover

mostly
much

never
nevertheless

occasionally
often

perfectly
perhaps
personally
probably
prompt

quite

really
recently

several
small
some (except when classifying soil)
subsequently
sure

the
therefore
tiny

undoubtedly
utilize

very

wherever
wherefore

APPENDIX B

LABORATORY OR INVENTOR'S NOTEBOOK

The Notebook

A laboratory or inventor's notebook should be a detailed, witnessed record of the entire history of an invention from its first conception to its reduction to practice. The notebook should contain a carefully detailed record of all research, hypotheses, experiments, thought processes that led to the experiments, and detailed recordings of experimental procedure, supplies, and equipment, including initial analysis or interpretation of experiments and trials. Although the notebook often serves as an organizational tool and a memory aid, its most important function is in protecting any intellectual property that may be a result from the research.

Laboratory notebooks belong to the institution housing the laboratory, not the person doing the research, and generally, laboratory notebooks should not leave the laboratory.

The laboratory notebook is not a legal document, *per se*, but if properly organized and maintained, it is of considerable value, as the notebook can help establish dates of conception and reduction to practice of the invention. Large company, university, or government laboratories keep a careful watch over their research notebooks. It is of utmost importance to recognize that while most notebooks may never be called upon once they are put into storage, if needed, the notebook can make the difference between being in a position to obtain a patent for your work or not.

Purpose of the Notebook

A patent grants its owners the right to sue those who make, use, sell, or import products or services that infringe on the claims declared in the patent. Typically, governments award patents on either a first to file (most foreign countries) or first to invent (the United States of America) basis. Therefore, it is can be of utmost importance to keep and maintain records that help establish who is first to invent a particular invention. The inventor's notebook is a device for systematically recording all information related to an invention so that it can be used to develop a case during a patent contestation or patent-related lawsuit.

Not too infrequently two, or more people, simultaneously and independently conceive of and invent the same product or process. Each inventor is likely to file an application for patent based on that invention. When applications, claiming the same invention, are filed close in time an interference proceeding may be called to determine which of the patent application has a right to priority. This process is a patent law procedure that is unique to the U.S.A. Most other countries have adopted the first-to-file system. The first-to-invent system of the U.S.A. allows a party which has failed to file a patent application on time to challenge the inventorship of another party who has a granted or pending patent. A carefully kept notebook can help an inventor to establish her inventorship.

How to Keep a Notebook

Guidelines for keeping lab notebooks may vary widely between individual laboratories, but some guidelines are fairly common. Thus, to be court acceptable proof, the notebook should have bound pages, that is, the pages should be sewn or otherwise permanently attached to the spine and cover of the notebook. To ensure that data cannot be easily altered, researchers are often encouraged to write only with permanent-ink pens. Laboratory notebooks should be inspected by an experienced member of the laboratory on a regular basis. The notebook may be elaborate in that it offers a permanently bound set of pages, the means to make an original and a copy of each page, and the means to remove the page copies. Ideally, data are entered into a notebook as the experiment progresses, on a daily basis if need be. Annotations should be added to provide extra credibility for the entry. For example, an entry could be annotated with the time, ambient temperature, and humidity measure in the laboratory. Such an entry could explain why a sample took an exceptional amount of time to dry and it also could be used to verify that the entry was made on the specified date.

Each page of the notebook should be twice signed and dated, once by the experimenter and once by a competent witness. Items may be stapled, taped, or glued onto a notebook page, but then each added entry also must be signed and dated by both the experimenter and the witness. This must be done so that a part of

each signature and date is on the attached material and part on the page onto which the material has been attached. These details are important if the notebook is to be used as court-acceptable proof. Each notebook page should be numbered. No numbered page should be missing. All pages should be filled in or marked in such a way that material may not be added after the fact, such as by putting a large cross mark across an empty space on a page. Initially, leaving a few blank pages at the beginning for a Table of Contents can save much time later on when a particular experiment has to be reviewed. Usually, when a notebook has been entirely filled, or a project comes to an end, the experimenter keeps the removable page copies for his record and the person responsible for the company, university, or government laboratory documents reviews the permanently bound set of pages to make sure the notebook is in a legally acceptable form, makes a record of the book, and then puts it into secure storage. The notebook, however, may just as well be a simple, composition book – the inexpensive notebook that has sewn-in pages. If data is recorded and witnessed completely and correctly, either type of notebook can provide the court-acceptable proof that will be needed if the inventive process should come into question.

If photographs of the experiment are to be used as part of the notebook, it is advised to use film photographs as digital photographs can be problematic for use in court proceedings.

Content of the Laboratory Notebook

Each entry in the Table of Contents should include the title of the experiment, the date, and the page number of the entry. The laboratory notebook must answer the following questions.

WHAT WAS DONE? This includes the approach to the problem or project, as well as the experimental procedure. If tests are conducted on some device, clearly identify that device and give characteristics. Include detailed explanation of materials and methods, protocol, reference to related experiments, calculation, any experimental amendments.

WHO DID IT? List all members of the lab group, including yourself, at the beginning of the write-up.

WHEN WAS IT DONE? It must be obvious to you or any reader when the experimental work was performed. Date all entries in the notebook. It is possible that a single experiment may have 2 or 3 different dates. Do not leave blank spaces and never "back-date" notebook entries.

WHAT WERE THE RESULTS? Data must be distinguished from calculated values. It should be obvious which measuring instrument yielded which data. Examples of each type of calculation must be given. Graphs must have titles, labels and scales are required for each axis. Do not "freehand" curves. The observation and result data should include everything that happens during the experiment, including everything that was expected or anticipated and did not.

WHAT DOES IT MEAN? The experimental observations should conclude with a discussion and conclusion. The results obtained and implications of the data should be discussed. In the conclusion, remarks may be made on the experiment in general and what is the logical next step. Be precise and concise. Compare your results to the theoretical (give reference). Specifically why do you believe or disbelieve the results? Discuss errors relative to the accuracy of the measurement equipment.

All writing that will facilitate data entry should be planned out in advance. Results may include: tables, charts, graphs, printouts, pictures, gels, films, and calculations.

There are many reasons to keep an accurate and complete record of experimental work. Among these are being able to establish the authenticity of the work, defend resulting patents, serve as a basis for technical reports and articles, avoid duplication of effort, and to avoid repetition of erroneous procedures. Your laboratory notebooks MUST contain all the information that would be required for you or someone else to completely reproduce your experiment.

Maintaining the Notebook

Record all observations as soon as possible. Check weekly to make sure that all data/printout/films are attached in a timely manner, that all required tables and graphs

are created, and entered. Draft a “Summary for the Past Week”, make plan for the following week, and record all experiments in the Table of Contents.

Electronic Notebooks

Several companies now offer electronic laboratory notebooks. This format has gained some popularity, especially in large pharmaceutical companies, which have large numbers of researchers and great need to document their experiments. A virtual inventor's notebook, in which the inventor scans note pages and emails them to oneself, might provide the same patent contestation protection and the same chronological record, and would be less likely to be lost or stolen. However, the confidentiality of this method should be carefully ascertained beforehand. Moreover, as digital copies are no longer allowed for evidentiary purposes in trial situations, it might be better to keep paper copies rather than electronic.

