AGRICOLA'S DE RE METALLICA: A 16TH-CENTURY LINK

IN THE EVOLUTION OF TECHNICAL WRITING

By

BOBBIE JO ALLEN

Bachelor of Arts
Meredith College
Raleigh, North Carolina
1980

Master of Arts
East Carolina University
Greenville, North Carolina
1983

AGRICOLA'S <u>DE RE METALLICA</u>: A 16TH-CENTURY LINK

IN THE EVOLUTION OF TECHNICAL WRITING

Thesis Approved:

_____
Thesis Adviser

_____

_____

_____

_____

_____
Dean of the Graduate College

1258557

ii

PREFACE

This dissertation evaluates Agricola´s <u>De</u> <u>Re</u> <u>Metallica</u>, a 16th-century Latin treatise on mining and metallurgy, as an historical sample of technical writing. From writing information ("Preface") to persuasion (Book I) to instructions (Book V), Agricola uses Aristotelian methods plus many elements recommended by 20th-century technical writing theorists. Such an analysis not only proves the evolution of technical writing, but of technical writing theories as well.

I am indebted to many friends who encouraged me while I was working on this dissertation. I thank my advisor, Dr. Thomas L. Warren, for his help, time, and direction. I also appreciate my committee members--Dr. Sherry Southard, Dr. Paul Klemp, Dr. Ed Walkiewicz, and Dr. Don Brown--for their prompt and helpful responses to each chapter. I am also grateful to Dr. Paul Epstein for his help with the Latin.

I also appreciate the invaluable help of Dr. Marcia Goodman, Dr. Duane Roller, and Dr. Thomas Smith from the University of Oklahoma´s History of Science Collection.

Special thanks go to my friends Suzanne Goodwin and Mary Head.

For helping me keep my sense of humor and perspective, I thank Sherry, Paul, Chris, Harvey, Connie, and Carlene. As always, I thank my family for their sympathy and support.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The number of schools offering scientific and technical writing

programs on the associates, bachelors, masters, and doctoral levels has

steadily increased over the past few years. In just the last four

years, this number has doubled, growing from 28 programs in 1981 to 56

in 1985 (Pearsall, et al.). Many programs already include or plan to

include a course in scientific and technical literature--a course that

typically traces the history of scientific and technical literature by

focusing on samples of this writing from the past.

The interest in such a course may surprise many people who con-

sider technical writing to be a modern discipline created in and for

the technological age of the 20th century and a purely pragmatic dis-

cipline unconcerned with literature or history, but rather solely

absorbed in contemporary aspects of communicating technical informa-

tion. This pragmatism cannot be denied without compromising technical

writing´s primary function: to bridge the gap between those who know

and those who need to know. That academic programs in technical

writing are primarily concerned with business and industry´s current

communication needs--and, therefore, concentrate on teaching students

to meet those needs--is also true.

In addition to these concerns, however, technical writers (like

professionals in other fields) are also interested in the roots of

their discipline. In spite of the somewhat prevailing belief that

technical communication is a modern phenomenon, it has actually existed for centuries--and probably since earliest communication. Even the grunts and gestures of prehistoric humans constituted technical communication if these signals provided instructions ("Go that way"), requisitions ("I want water"), or mechanism descriptions ("This is how a knife cuts").

Indeed, it is not at all unreasonable to assume that such forms of technical communication did occur and, therefore, did contribute to the survival of the human species. With this understanding, we should not be surprised that the corpus of technical writing probably dates from the first forms of writing, generally estimated to be circa 4000 B.C. with the writings of the Sumerians (Pei, 27-8). One of the oldest samples of technical writing is a Babylonian clay tablet dated circa 2000 B.C. Housed in the New York Metropolitan Museum of History, this clay tablet tells its readers how to make beer. It would be rash to suggest that this tablet is the beginning of technical writing. Rather, it is much more logical (though equally unprovable) to assume that this tablet is just one surviving sample of the kind of technical writing that had been extant for years, and probably centuries, prior to 2000 B.C.

The history of technical writing moves from this clay tablet's instructions for making beer through each century's various lessons on topics such as classifying animals (Aristotle, 4th century, B.C.), evaluating and treating illnesses (Galen, 2nd century, A.D.), restructuring education (Francis Bacon, 16th and 17th centuries, A.D.), and building nuclear power plants (20th century, A.D.). Contemporary technical writing has not abandoned its messages of the past; writers still instruct readers on making beer, classifying animals, diagnosing

and treating illnesses, and restructuring education. The subjects of technical writing, however, have broadened in proportion to the constantly growing number of technological developments.

From its obscure beginnings, therefore, technical writing has evolved into the 1980's documents on nuclear power, medical procedures, and how-to-do-anything-better guides.[1] Rather than a strictly modern discipline, technical writing stands with other fields (medicine, law, engineering, and so on) as an ancient discipline with a continuing tradition for developing and incorporating new knowledge to serve humanity. In fact, we know the history of these other fields only because some technical writer thought it appropriate to record contemporary events in a particular field—events that come into the 20th century as historical accounts. In documenting the history of these other disciplines, technical writing has documented its own history. Because no technical writing textbook existed before the 20th century,[2] we know nothing of what our predecessors used as guidelines for conveying technical information. We have only these historical samples of technical writing that show how these early technical writers structured their information. Modern technical writers, therefore, may be surprised to learn that many of these historical samples of technical writing apply what are often considered 20th-century ideas governing good technical writing: content, patterns of organization, and rhetorical devices consciously chosen and directed to a particular reading audience.

Purpose of the Dissertation

In this dissertation, I will discuss Georgius Agricola's <u>De Re Metallica</u>, a 16th-century Latin treatise on mining and metallurgy, as

an historical sample of technical writing. The primary focus of the dissertation is Agricola's awareness of his audience and its needs for information--regardless of whether his purpose is to inform, to persuade, or to instruct. In fact, the purpose of each book of De Re Metallica indicates Agricola's concept of his audience.

I will analyze the audience(s) of De Re Metallica by comparing the content, organization, and rhetorical strategies of three sections of the treatise. The analysis will show that Agricola was aware of 1) various readers and their backgrounds and reasons for reading De Re Metallica (evidenced by his choice of content), 2) various techniques for arranging information to meet his audience's needs (evidenced by his organizational strategies), and 3) several levels of reader specialization and familiarity with the information he presents (evidenced by his use of rhetorical strategies).

Where would Agricola have learned such strategies? The Hoovers' introductory biography of Agricola shows that he was educated at the University of Leipsic, where he graduated with a bachelor of arts degree. He later became the vice principal of the Municipal School at Swickau, where he taught Latin and Greek. His knowledge of languages makes it reasonable to presume that he was well-educated and well-versed in both organizational and rhetorical strategies.

As for his knowledge of mining and metallurgy, Agricola spent a great deal of time observing the various techniques and processes involved in these two crafts. Joachimsthal, where Agricola was a practicing physician, was a "booming mining camp" (Hoover and Hoover, vi). As the Hoovers say,

According to Agricola's own statement [in the "Preface to <u>De</u> <u>Veteribus</u> <u>et</u> <u>Novis</u> <u>Metallis</u>], he spent all the time not required for his medical duties in visiting the mines and smelters, in reading up in the Greek and Latin authors all references to mining, and in association with the most learned among the mining folk. . . . Agricola seems to have resigned his position at Joachimsthal in about 1530, and to have devoted the next two or three years to travel and study among the mines (vi-vii).

It was about 1530 that Agricola began work on <u>De Re Metallica</u>, a project that required over twenty years' work (Hoover and Hoover, xv).

Justification for the Dissertation

Because of technological developments since 1556, when <u>De Re Metallica</u> was first printed, it is hardly surprising that most of the information and instructions in the work have been long outdated. That the work was once important for its information, however, is un-deniable:

> During 180 years it was not superseded as the text-book and guide to miners and metallurgists, for until Schluter's great work on metallurgy in 1738 it had no equal. That it passed through some ten editions in three languages [Latin, German, and Italian] at a period when the printing of such a volume was no ordinary undertaking, is in itself sufficient evidence of the importance in which it was held, and is a record that no other volume upon the same subjects has equalled since (Hoover and Hoover, ii).

In part of his work focusing on various influences on Francis Bacon and his writings, Benjamin Farrington discusses the reception and influence of De Re Metallica:

> The Latin original was at once known in England. But the book was soon available also in a modern tongue under circumstances which suggest its reputation among the English in the middle of their first industrial revolution. Michael Angelo Florio, son of an Italian Jew who had become a Christian, fled to London, where he was befriended by Burleigh and appointed preacher to the Italian Protestant congregation. As an acceptable token of his gratitude to his hosts he translated De Re Metallica into Italian and dedicated the volume to Queen Elizabeth in 1563. The book was from the first an indispensible textbook. . . . It put on record Agricola's experience of the Bohemian mines and made it available for application throughout the world. It enabled the Spaniards to exploit the inexhaustible mineral wealth of Bolivia. At Potosi the priests chained it to the altar so that the engineers, who perforce had recourse to use it, might be reminded also of their religious duties (33-4).

As important as De Re Metallica was for 180 years to practicing miners and metallurgists, the work is still valuable as "our main source of information about metals production at the start of the modern era" (Miller and Saidla, 68). For this dissertation, of course, the importance of the work is its contribution to the history of technical writing.

Scope of the Dissertation

To discuss all of De Re Metallica would be exhaustive and unneces-
sary for the scope of this dissertation. Because I focus on three of
Agricola's purposes for writing, I use only three sections of the
treatise to discuss those purposes: the "Preface," Book I, and Book V.
The "Preface" introduces the topics and how he plans to handle these
subjects. Book I is persuasive, defending mining and metallurgy as not
only worthwhile, but vital practices for the continually improving
lifestyle of mankind. Book V instructs readers on "underground mining
and the art of surveying" (Hoover and Hoover, 101) {1}. In evaluating
Agricola's success in achieving his various purposes, I rely on the
analysis of three aspects of his writing: content, organization, and
rhetorical strategies. Agricola manipulates each of these elements
according to his purpose and the evaluation of his audience and their
needs for information.

When discussing content, I do not evaluate the accuracy of the
information because most of it is long outdated, making any attempt to
verify its accuracy pointless. Further, to do so would require an
exhaustive knowledge of mining and metallurgy. Instead, I will use
content to show what Agricola thought his audience needed to know and
to give my own readers a context for the subsequent discussions of
organization and rhetorical strategies.

The discussion of organization includes the arrangement of
material within the section, based on samples Agricola may have used as
models for his work and comparing his work to what 20th-century
theorists have concluded about organizational strategies for various

types of information and various purposes for writing.

Finally, analyzing Agricola's use of rhetorical strategies will show his perception of how much background his readers have in mining and metallurgy and how quickly they should be able to understand his message. We can assume that when Agricola presents, say, three examples to illustrate a point, he perceives that information to be much more complex than the material he illustrates with only one example.

The result of this type of analysis should be useful as it helps establish 1) part of the history of technical writing, 2) Agricola's various readers' backgrounds and reasons for reading the technical treatise, 3) the various organizational and rhetorical strategies for communicating with a variety of readers for a variety of purposes, and 4) the relationship between the history of technical writing and 20th-century theories about technical writing.

Methodology of the Dissertation

The greatest problem in analyzing historical samples of technical writing also causes problems in the methodology of such an analysis: working with a non-English original. In fact, until the 16th century, few historical samples of technical writing were written in English; most writers used Latin to communicate their information. The Renaissance writer typically viewed English as an "uneloquent tongue that could achieve elegance only by borrowing heavily from Latin" (Gordon, 13). Moreover, many of these writers wrote solely in Latin, not just interspersing their English with Latin phrases.

The rise and development of English prose created great consternation among prose writers over whether to write in English or Latin.

Opposing Sir Thomas Elyot and other champions of Latin, writers such as Wilson, Cheke, and Ascham "damned the Latin neologisms, the ´inkhorn terms´ . . . and found their own language ´adequate´ and even ´plentiful´" for communicating their information (Gordon, 75).

One reason for the tenacity of Latin during the Renaissance was that it was the most widely read language. But speakers of English are left with two problems in studying non-English samples of technical writing such as Agricola´s De Re Metallica:

> 1) If we analyze the translation, is it not likely that our results draw stylistic conclusions about the translator´s rather than the writer´s work?
>
> 2) If we analyze the work in its original language, what good have we done for those who do not know that original language? Have we not excluded them from being able to duplicate our analysis?

Ignoring these questions is impossible, and one way or another, it seems inevitable that our analysis will be dubious. It is equally negligent, however, to disregard works that have lasted centuries on the sole basis that they were not written in English. This criterion would require dismissing the works of writers such as Aristotle, Galen, Hippocrates, and Einstein—works that are significantly influential in the history and development of technical writing.

Part of the methodology for this dissertation, therefore, is to use both the original Latin and the English translation when discussing passages from De Re Metallica. Within the text of the dissertation, I will use the English translation of the passage; for those who want to

check the English against the original Latin, I have included the verbatim Latin passages in Appendix A and have numbered them within the text with {}. When there are no discrepancies between my translation and the Hoovers' English translation (and there are, to the Hoovers' credit, remarkably few discrepancies), I use the Hoovers' for continuity and note the reference to their translation. To verify the translation, I use both a medieval Latin dictionary and a modern dictionary (because some of the words are not included in the medieval dictionary).[3]

For the analysis itself, I have researched technical writing sources that contribute information on various audiences and their needs for information. I have also researched and summarized the 20th-century theories for informing, persuading, and instructing readers. Finally, I have studied the kinds of information, organization, and rhetorical strategies that are most useful for the writer's audience and purpose. By combining these three forms of analysis, I can draw specific conclusions about Agricola's audiences for the three sections of De Re Metallica. The diagram below shows how this analysis works to allow conclusions about Agricola's perceived audience(s).

Purpose

Information Needed
(Content)

Order Needed
(Organization)

Clarity Needed
(Rhetorical Devices)

Audience
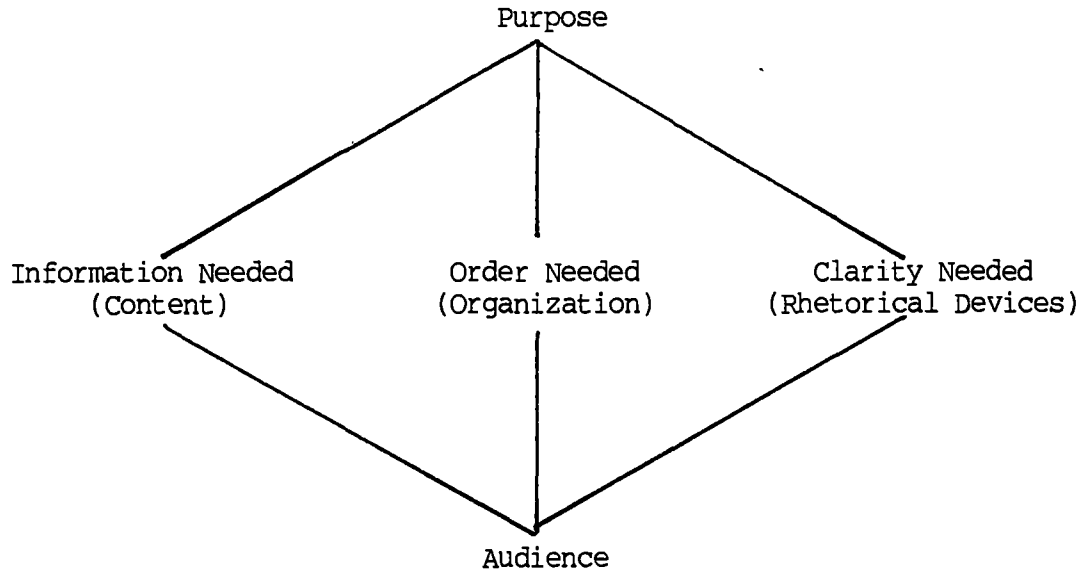
Figure 1: Diagram of Analysis for the Dissertation

Definitions

Because I will be discussing the content of the three sections of

De Re Metallica, certain terms (for example, some of the Latin words

for which neither the Hoovers nor I can find acceptable translations)

will have to be explained. These definitions, however, are more appro-

priately included in the text as the terms occur. Because this set of

terms and their definitions are not operational or crucial for

analyzing Agricola's writing, it would be tedious to place and define

these terms here.

Other terms basic to this analysis—such as stylistic terms—are

operational and must be defined here. As I have said earlier, this

dissertation looks at three of Agricola's purposes for writing: inform-

ing (introducing), persuading, and instructing. By informing, I mean

presenting a subject for the sole purpose of enhancing the reader's

knowledge. By <u>persuading</u>, I mean presenting a subject to change the reader's thoughts or behavior. And by <u>instructing</u>, I mean presenting a subject as a methodical procedure so the reader can follow the steps and accomplish the task.

Finally, it seems only fair to define the primary subjects of <u>De Re Metallica</u>: mining and metallurgy. <u>Mining</u> is the act of finding, digging, and extracting ores from the earth. <u>Metallurgy</u>, the process that follows mining, is the act of separating metals from their ores or of combining metals with other metals or non-metals. (For example, metallurgists commonly combine gold with other alloys to make it hard enough for jewelry.)

Plan of Development

All aspects of technical writing relate to the specific audience for whom the writing is intended. The content, for example, develops according to what the reader needs to know. The organization of that content should present information as the reader would logically expect or need to find it (or at least tell the reader where to find it). Rhetorical strategies, such as analogies, metaphors, questions, and so on, help the reader comprehend messages.

The writer manipulates these technical writing aspects according to the purpose for writing. Writing instructions, for instance, requires first-hand knowledge of the process in order to write the content. It also requires that the writer present the order of that process exactly—chronologically from the first to the last step. Certain rhetorical strategies can also be useful if the process has steps similar to those of a more commonplace process. A writer may choose, for example, to compare tying a surgical knot to tying a sewing

knot. This kind of analogy not only simplifies the information, but may also reduce the reader's anxiety about performing the more sophisticated process.

The purpose for writing, therefore, creates certain constraints on the writing process--from deciding what kind of information to include, to organizing that information for the reader's benefit, to using rhetorical strategies to clarify the complexities of that information. This dissertation presents these constraints according to Agricola's purposes for writing the various sections of De Re Metallica. Chapters 2 and 3, therefore, will follow the same plan of development. Chapter 4 deviates from this plan of development because of the inaccessibility of guidelines for writing instructions in the 16th century. Chapter 4 will apply semiotic theory to the instructions of Book V of De Re Metallica, based on Elizabeth Harris's essay, "A Theoretical Perspective on 'How To' Discourse." The conclusions for Chapter 4, like the conclusions for Chapters 2 and 3, combine a discussion of Agricola's methods for achieving his purpose for writing with what those methods tell us about his perceived audience(s).

Chapter 5 summarizes and concludes the dissertation. It includes implications for classroom applications, for further research into De Re Metallica, and for further research into the history of technical writing and technical writing theories.

NOTES

1

For more information on articles on the history of scientific and technical writing, see John R. Brockmann. "Bibliography of Articles on the History of Technical Writing." Journal of Technical Writing and Communication 13 (1983): 155-65. For a literature review and bibliography of articles on the history of ancient, medieval, and Renaissance scientific and technical writing, see Michael G. Moran and Debra Journet, eds., Research in Technical Communication: A Bibliographic Sourcebook (Westport, CT: Greenwood Press, 1985) 26-8.

2

In his article "The First Textbook on Technical Writing," Journal of Technical Writing and Communication 7 (1977): 51-4, Richard Schmelzer claims the first technical writing textbook was Ray Palmer Baker (The Preparation of Reports: Engineering, Scientific, Administrative. [New York: The Ronald Press Company, 1924.]) There is some dispute as to the accuracy of Schmelzer's claim, but to date, no one has found a technical writing textbook that predates the 20th century.

3

Dictionaries used are R. E. Latham, Revised Medieval Latin Word-List: From British and Irish Sources (London: Oxford UP, 1965) and D. A. Kidd, Latin-English: English-Latin (1957; London: William Collins Sons & Co. Ltd., 1982).

CHAPTER II

THE "PREFACE" AS A TECHNICAL WRITING INTRODUCTION

Communicating, in its simplest definition, links the person(s) sending a message to the person(s) receiving and comprehending that message. In addition, the message sender must find some appropriate channel for sending that message (writing, speaking, signing, gesturing, or whatever). Without all these elements, no communication is possible.

Of the many purposes for communicating, the greatest is informing, for whenever humans communicate, they are informing. Even when people ask questions, they are informing--either "I do not understand," "I would like to know more," or even "I know, but I am not convinced that you know." The fragments of communication, such as "hello," "nice day," or "how are you?" exist and persist as a means of informing others that we wish to have some contact with them--whether that contact is brief (two strangers in an elevator) or whether it is based on a more extensive relationship (a husband and wife reuniting after a day at work).

This importance of informing is also evident in the "Preface" of Agricola's De Re Metallica. Although Agricola has three purposes for writing (informing, persuading, and instructing), his writing is ultimately informative. When he instructs readers, he informs them of methods for accomplishing a task. When he persuades readers, he informs them of his views and his rationale for holding those views,

which in turn teach something about the writer. (I will discuss these points further in Chapters 3 and 4.)

Methods of Informing: The Introduction

Often one of the most difficult parts of writing any document is deciding how to introduce that document. What kind of information does the reader need first? Edward P. J. Corbett says,

> The basic function . . . of the introduction is to lead the audience into the discourse. . . . Generally this preparation of the audience has a twofold aspect: (1) it informs the audience of the end or object of our discourse, and (2) it disposes the audience to be receptive to what we say (303).

Of course, Corbett's statements paraphrase Aristotle's statements in the Rhetoric where he says, "This, then, is the superlative function of the proem [introduction], this its distinctive task: to make clear the end and object of your work" (223). The second part of Corbett's qualifications also paraphrases the information in the Rhetoric. After presenting some strategies for charming the audience, Aristotle says, "You may use each and all of these means, if you like, in your proem, with a view to making your audience receptive, and withal give an impression of yourself as a good and just man, for good character always commands more attention" (224).

Although Aristotle's Rhetoric addresses speaking as its mode of communicating (or its channel), this information about the proper content of an introduction applies to writing as well. We presume that Agricola had studied the Rhetoric because "Agricola's education was the

most thorough that his times afforded in the classics, philosophy, medicine, and the sciences generally" (Hoover and Hoover, xii). We know that Aristotle was traditionally studied in the schools of the 16th century--including the Italian University where Agricola studied.[1] The Hoovers add that Agricola was "to a certain distance a follower of Aristotle" (xii)--a possibility that gains strength during the course of this dissertation.

At any rate, Agricola certainly uses Aristotelian concepts for developing information, and Agricola's methods survive in the technical writing of the 1980's. Most technical writing textbooks have elaborated on Aristotle's advice and present a more comprehensive strategy for developing introductions that prepare readers for the information that follows. This strategy includes the writer's answering certain questions about the work:

What is the subject of my work? (subject)

What do I want readers to gain from reading? (purpose)

Who should read the work? How much background do they need to be able to understand the work? (audience)

How many details do I need to provide? How broad should this project be? (scope)

How will I get the information I need to write this project? (methodology)

Are there any terms that my reader may not know? Have I used any term in a special way that may confuse my reader? (definitions--optional)

How can I organize the information so readers can follow the logic of information? (plan of development)

(Sophisticated technical writers typically combine the answers to some of these questions, which prevents a monotonously predictable six- or seven-sentence introduction for every technical document.)

By answering these questions, the writer not only prepares the reader for the information included in the work, but may also help direct the reader by answering the following reader-oriented questions:

1) Can I expect to find the information I need in this work? Or should I look elsewhere for the information?

2) Do I have to read the entire work for the information I need? Or can I read only a portion of the work to answer my questions? And which specific part(s) of the work should I read to find these answers?

Any introduction that fails to answer these questions may cost the reader time. Because most readers of technical documents are busy readers--they are not reading for pleasure or for entertainment, but for pertinent information--an ineffective introduction is a serious flaw in a technical work.

In addition to including the subject, purpose, audience, scope, methodology, necessary definitions, and plan of development, some introductions include additional information, such as background (or history) of the topic and reviews of pertinent literature, to help orient the reader. Corbett discusses these kinds of prefatory remarks or passages:

Conceivably, an audience could be well enough informed about a subject and sufficiently predisposed to our favor that the

introduction could be made very brief or might be dispensed
with entirely. Even under those conditions, however, most of
us would feel that some kind of prelude was necessary—if
nothing else a joke, an apt quotation, an entertaining anec-
dote, an ingratiating gesture toward the audience. . . .
Without this kind of "ornamental" introduction, the discourse
would have an abrupt, negligent, unfinished air about it. So
it is a rare discourse that plunges immediately into "the
heart of the matter" (303-04).

This strategy for orienting the reader, therefore, may be as important
in the introduction as the other elements already discussed. Agricola
tries to orient his readers at the beginning of his "Preface." The
next section of this chapter ("Content") will show how Agricola orients
his reader, how he uses the Aristotelian concepts for writing an intro-
duction, and how he uses other technical writing methods for more fully
developing the information in the introduction.

Content of the "Preface"

What is especially interesting about Agricola's "Preface" to De Re
Metallica is that he bases his information on the Aristotelian concept
of readers' needs for information. And, as a sort of anachronistic
addition, he also uses the elements of the standard technical writing
introduction to develop that information—in spite of the fact that
these elements were not explicitly identified until the advent of 20th-
century technical writing textbooks. (See Appendix B.) I do not mean
to suggest that Agricola was the first to develop an introduction with
all these elements. That he did use both the Aristotelian and 20th-

century methods of developing his "Preface," however, strengthens the argument that studying De Re Metallica as a link in the evolution of technical writing does hold merit.

In this section, I will discuss the content of Agricola's "Preface" in terms of Aristotle's two suggestions for an effective introduction. Within those two suggestions come the methods advanced by 20th-century technical writing scholars on how to develop information. The information, therefore, breaks down into the following schema:

(1) "to make clear the end and object of your work" (Aristotle, 223)

- o subject
- o purpose
- o scope
- o audience
- o methodology
- o definitions, if necessary
- o plan of development

(2) "to [make] your audience receptive" (Aristotle, 224)

- o worthiness of subject
- o need for information
- o quality of the study

According to this breakdown, current technical writing theory emphasizes the first goal of the Aristotelian introduction by pointing out concrete methods of development. Although the second part (the persuasive part) of the introduction is not neglected in technical writing, it does receive less emphasis than the first part of an introduction—at least judging from the amount of theory available on the persuasive elements of the technical writing introduction. Discussing Agricola's "Preface," therefore, will require using current technical writing

theory for the first part of the discussion and using Aristotle's
Rhetoric for the second part.

Making Clear the End and Object of the Work

Any discussion of a work's clarity demands a careful analysis of
the readers of that work. What is clear to one group of readers may
certainly not be clear to another group of readers. Factors such as
background in the subject, interest in the subject, reading level, and
familiarity with the language, and others all affect the perception of
clarity in a work.

Agricola's intended audience may be somewhat confusing for the
first-time reader of his "Preface" because he begins with a dedication
that reads,

> TO THE MOST ILLUSTRIOUS AND MOST MIGHTY DUKES OF Saxony,
> Landgraves of Thuringia, Margraves of Meissen, Imperial
> Overlords of Saxony, Burgraves of Altenberg and Magdeburg,
> Counts of Brena, Lords of Pleissnerland, to MAURICE Grand
> Marshall and Elector of the Holy Roman Empire and to his
> brother AUGUSTUS (xxv) {2}.

The idea of dedicating a work to a political figure or to a financial
sponsor was a rather typical strategy in Renaissance writing that
served several possible functions. Some dedications were simply the
writer's means for thanking a supporter, whether a financial supporter
or someone who encouraged the author's work. Other dedications were
more politically motivated; the writer may have wanted to win or keep
the favor of someone in office. Occasionally, the work really was

written for that specified reader or group of readers named in the dedication, but more often the dedication was flattering those named rather than specifying them as the intended audience of the work.

Agricola's dedication recognizes and thanks those in office who evidently encouraged his work. The Hoovers say, "Agricola was much favoured by the Saxon Electors, Maurice and Augustus. He dedicates most of his works to them and shows much gratitude for many favours conferred upon him. Duke Maurice presented to him a house and plot in Chemnitz . . ." (ix). Agricola also worked with these princes as a diplomat and advisor, which substantiates the personal relationship he had with them and their esteem for him (Hoover and Hoover, x).

Although he gives the princes good reason for reading De Re Metallica--"because metals have proved of the greatest value to you"-- they are not his primary audience (Hoover and Hoover, xxxi) {3}. He combines the first concrete evidence of his designing the work for a particular group of readers with his purpose for writing De Re Metallica:

> Since no authors have written of this art in its entirety,
> and since foreign nations and races do not understand our
> tongue, and, if they did understand it, would be able to
> learn only a part of the art through the works of those
> authors whom we do possess, I have written these twelve books
> De Re Metallica (Hoover and Hoover, xxix) {4}.

Agricola's practice of combining elements of the introduction continues when he joins his subject with another similar statement of his purpose; this sentence, in fact, opens the "Preface":

. . . [O]ften have I considered the metallic arts as a whole
. . . and when I had perceived the various parts of the
subject, like so many members of the body, I became afraid
that I might die before I should understand its full extent,
much less before I could immortalize it in writing (Hoover
and Hoover, xxv) {5}.

Although the Hoovers´ translation is correct, they do break Agricola´s
first sentence into two English sentences (probably to prevent the
length of this sentence from immediately overwhelming contemporary
readers). The remainder of Agricola´s first sentence reads, "This book
itself indicates the length and breadth of the subject, and the number
and importance of the sciences of which at least some little knowledge
is necessary to miners" (Hoover and Hoover, xxv) {6}.

As a first sentence, this introductory statement indicates his
subjects and purpose for writing, not to mention his esteem for the
subjects´ importance. Furthermore, the sentence indicates the scope of
De Re Metallica--that Agricola intends to be thorough and cover every
topic relating to mining and metallurgy. Bern Dibner says, "At a time
when most industrial processes were held secret by families, guilds, or
towns, Agricola saw fit to publish every practice and improvement that
he considered of value . . ." (25). What Agricola considers important
becomes evident in his plan of development, which more precisely
describes the scope of his work. (I discuss the plan of development
later in this chapter.)

Following this introductory statement disclosing his subject and
purpose is a sentence that serves as the justification of the work. He
says of mining, ". . . [S]ince the art is one of the most ancient, the

most necessary and the most profitable to mankind, I considered that I ought not to neglect it" (Hoover and Hoover, xxv) {7}. Then he further justifies the work by explaining just how ancient, how necessary, and how profitable mining is.

In spite of the importance of mining and metallurgy, however, Agricola emphasizes that few authors have dealt with these subjects-- and no one has produced a thorough study of the two. He discusses other sources on mining and metallurgy but points out that he can use only one source: Pliny's Naturalis Historia. And even this work is flawed in that Pliny "expounds only a very few methods of digging ores and of making metals" (Hoover and Hoover, xxvi) {8}. And of the writing on mining and metallurgy in general, Agricola complains, "Far from the whole of the art having been treated by any one writer, those who have written occasionally on any one or another of its branches have not even dealt completely with a single one of them" (Hoover and Hoover, xxvi) {9}. He then discusses the few works that are available and explains their flaws.

When discussing the available works on mining and metallurgy, Agricola mentions the alchemists, a tangential group of researchers that warrant suspicion in his opinion:

> . . . [A]lthough it may be due to the carelessness of the writers that they have not transmitted to us the names of the masters who acquired great wealth through this occupation, certainly it is clear that their disciples either do not understand their precepts or, if they do understand them, do not follow them; for if they do comprehend them, seeing that these disciples have been and are so numerous, they would

have by to-day filled whole towns with gold and silver. Even

their books proclaim their vanity, for they inscribe in them

the names of Plato and Aristotle and other philosophers, in

order that such high-sounding inscriptions may impose upon

simple people and pass for learning (Hoover and Hoover,

xxviii-xxix) {10}.

The Hoovers support the problems with documentation that stem from

unauthorized or misattributed sources (Hoover and Hoover, xxviii, fn

12). From his references to other sources (whether valid or spurious)

showing what information is and is not available about mining and

metallurgy, Agricola proceeds to outline what his work will cover.

This twelve-sentence plan of development establishes the order of the

information in De Re Metallica and also clarifies the scope of the

work:

> . . . [T]he first book contains the arguments which may be
>
> used against this art, and against metals and the mines, and
>
> what can be said in their favour. The second book describes
>
> the miner, and branches into a discourse on the finding of
>
> veins. The third book deals with veins and stringers, and
>
> seams in the rocks. The fourth book explains the method of
>
> delimiting veins, and also describes the functions of the
>
> mining officials. The fifth book describes the digging of
>
> ore and the surveyor's art. The sixth book describes the
>
> miners' tools and machines. The seventh book is on the
>
> assaying of ore. The eighth book lays down the rules for the
>
> work of roasting, crushing, and washing the ore. The ninth
>
> book explains the methods of smelting the ores. The tenth

book instructs those who are studious of the metallic arts in the work of separating silver from gold, and lead from gold and silver. The eleventh book shows the way of separating silver from copper. The twelfth book gives us rules for manufacturing salt, soda, alum, vitriol, sulphur, bitumen, and glass (Hoover and Hoover, xxx) {11}.

Having established the outline for covering all of these elements of the subjects, Agricola recognizes certain factors that may hinder reader comprehension. He recognizes, for instance, that terminology may be a problem for his readers and that this problem may persist regardless of the language he uses. To help alleviate this problem, Agricola uses illustrations--an appropriate method for "defining" some thing or process when language may be a barrier to understanding. In fact, Agricola includes over three hundred illustrations (not to mention charts and geometric drawings) throughout his work. He explains,

> . . . I have devoted much labour and care, and have even gone to some expense upon it [De Re Metallica]; for with regard to the veins, tools, vessels, sluices, machines, and furnaces, I have not only described them, but have also hired illustrators to delineate their forms lest descriptions which are conveyed by words should either not be understood by men of our own times, or should cause difficulty to posterity, in the same way as to us difficulty is often caused by many names which the Ancients (because such words were familiar to all of them) have handed down to us without any explanation (Hoover and Hoover, xxx) {12}.

Although we do not know who drew the illustrations (Hoover and
Hoover, xv), the quality and quantity of the drawings are quite impres-
sive in their detail and their contribution to the clarity of the text.
For example, the first illustration in the treatise shows a man using a
tree branch, or a divining rod, to search for a vein of ore—similar to
the way some people have used branches or divining rods to search for
water. (See "A" on Figure 2 on the next page.) Though most of
Agricola's illustrations show what to do rather than what not to do, he
presents this "negative" illustration and dismisses these twigs as a
superstition (Hoover and Hoover, 41).

As with all the illustrations in De Re Metallica, the emphasized
parts of this illustration are labeled with capital letters and
correspond to the legend underneath the visual. Although Agricola does
not always interrupt the flow of his text to refer to his visuals,
these illustrations are strategically placed (whether by Agricola or by
the printer) to complement the text. Invariably, the drawings do help
the reader understand Agricola's message, in spite of the fact that
some of the capital letters in the illustrations may be momentarily
indiscernible because of the intricacy of the drawings.

Next, Agricola discusses his methodology for De Re Metallica.
From the earlier note on Agricola's skepticism of the alchemists'
claims and methodology, we can presume that Agricola would not adopt
the same system of research for his work. Indeed, he does dismiss the
alchemists' questionable methodology and, in turn, strengthens the
Aristotelian style of research (later adopted and revitalized by the
Royal Society of London) that emphasizes observation over philosophical

A—TWIG. B—TRENCH.

Figure 1: Illustration of Miners Using "Twigs" to Find Veins of Ore

[Source: Agricola, De Re Metallica, trans. Herbert Clark Hoover and
Lou Henry Hoover (New York: Dover, 1950), p. 40.]

speculation.   Explaining the methodology of his work, Agricola writes,

> I have omitted all those things which I have not myself seen,
> or have not read or heard from persons upon whom I can rely.
> That which I have neither seen, nor carefully considered
> after reading or hearing of, I have not written about. The
> same rule must be understood with regard to all my instruc-
> tion, whether I enjoin things which ought to be done, or
> describe things which are usual, or condemn things which are
> done (Hoover and Hoover, xxxi) {13}.

Dibner commends Agricola as one of the first to think of research from
this point of view, adding that Agricola's approach "helps explain why
so much of his text is devoted to refutation of the many ancient and
deep-rooted beliefs of the scholastics" (24).

Part of his methodology also addresses his concern for terminology
and definitions. Although he has already said that he provides illus-
trations to help clarify problems with terminology, he recognizes that
illustrations alone may not allay all the problems because many of the
terms in mining "lack names, either because they are new, or because,
even if they are old, the record of the names by which they were
formerly known has been lost" (Hoover and Hoover, xxxi) {14}. Then he
explains the consequences of this lack of information:

> For this reason I have been forced by a necessity, for which
> I must be pardoned, to describe some of them by a number of
> words combined and to distinguish others by new names. . . .
> Other things, again, I have alluded to by old names . . . and
> if anyone does not approve of these names, let him either

find more appropriate ones for these things, or discover the
words used in the writings of the Ancients (Hoover and
Hoover, xxxi) {15}.

Making the Audience Receptive

The second part of Aristotle's advice about writing an introduc-
tion is more persuasive than informative. Because the "Preface" is
only occasionally persuasive (it is predominantly informative), I in-
tend to mention only the few persuasive passages here and describe
their possible effects on Agricola's readers. A thorough analysis of
Agricola's persuasive techniques is in the next chapter, which focuses
on Book I; in fact, Agricola develops Book I using persuasive tech-
niques almost exclusively.

Mills and Walter say that one of the functions of the introduction
may be "to explain the value or importance of the subject" (226). Cer-
tainly, the first sentence of the "Preface" does just that. Speaking
of mining, Agricola says, "I became afraid that I might die before I
should understand its full extent, much less before I could immortalize
it in writing" (Hoover and Hoover, 1) {16}. To feel such an urgency
about any project reflects that project's importance to the writer.
But Agricola projects that importance to and for his readers as well.
He compares the importance of mining to the importance of agriculture,
saying "they are at least equal and coeval, for no mortal man ever
tilled a field without implements" (Hoover and Hoover, xxv) {17}.
Then, he appeals to his readers' financial interests: "[O]ne mine is
often much more beneficial to us than many fields. For this reason we
learn from the history of nearly all ages that very many men have been
made rich by the miners, and the fortunes of many kinds have been much

amplified thereby" (Hoover and Hoover, xxv-xxvi) {18}.

Even the conclusion of the "Preface" attempts to make readers more receptive. Although he re-addresses the princes in this conclusion, most readers (at least those who are motivated by the prospect of getting rich) can see potential in mining and metallurgy as a means of attaining wealth. Agricola ends the "Preface" with a persuasive prod to his readers that should heighten their interest in his subjects and convince them of the value of reading the rest of the work:

> These books, most illustrious Princes, are dedicated to you
> for many reasons, and, above all others, because metals have
> proved of the greatest value to you; for though your ances-
> tors drew rich profits from the revenues of their vast and
> wealthy territories, and likewise from the taxes which were
> paid by the foreigners by way of toll and by the natives by
> way of tithes, yet they drew far richer profits from the
> mines. Because of the mines not a few towns have risen into
> eminence, such as Freiberg, Annaberg, Marienberg, Schneeberg,
> Geyer, and Altenberg, not to mention others. Nay, if I
> understand anything, greater wealth now lies hidden beneath
> the ground in the mountainous parts of your territory than is
> visible and apparent above ground (Hoover and Hoover, xxi)
> 2
> {19}.

Of course, other passages in the introduction are also persuasive to some extent. These passages tend to focus less on the possibility of wealth to motivate readers and more on the readers' quest for ac-curate and comprehensive information. (One could say, for instance,

that the methodology section of the "Preface" is persuasive—as it certainly is for the reader whose primary criterion for deciding whether to read a work hinges on the writer's statement of methodology.) The more esoteric reader, therefore, will probably continue reading De Re Metallica regardless of the financially persuasive passages, having already been persuaded by the subject, purpose, methodology, and scope that the work merits reading.

Organization of the "Preface"

Although successful writers generally present information in a particular order based on a logical arrangement of their ideas, "the organization of the whole introduction is affected by the selection of the proper initial emphasis" (Mills and Walter, 231). In other words, as long as all the vital information is in the introduction, the arrangement of that information depends exclusively on what the writer chooses to emphasize.

The arrangement of information in Agricola's "Preface" is the heart of the introduction and is encapsulated by the opening and concluding persuasive parts of the introduction. His opening, therefore, emphasizes the importance of his subject. Then he develops the elements of the standard technical writing introduction, and again he structures a sort of capsule for his information. The literature review of other sources on mining and metallurgy, combined with his plan of development, constitute the bulk of this section. He surrounds that corpus with his purpose, audience, methodology, and definitions in one or two sentences, unlike the fully-developed sections (which the Hoovers break into paragraphs) he devotes to sources and the plan of development. (See Figure 3 below.)
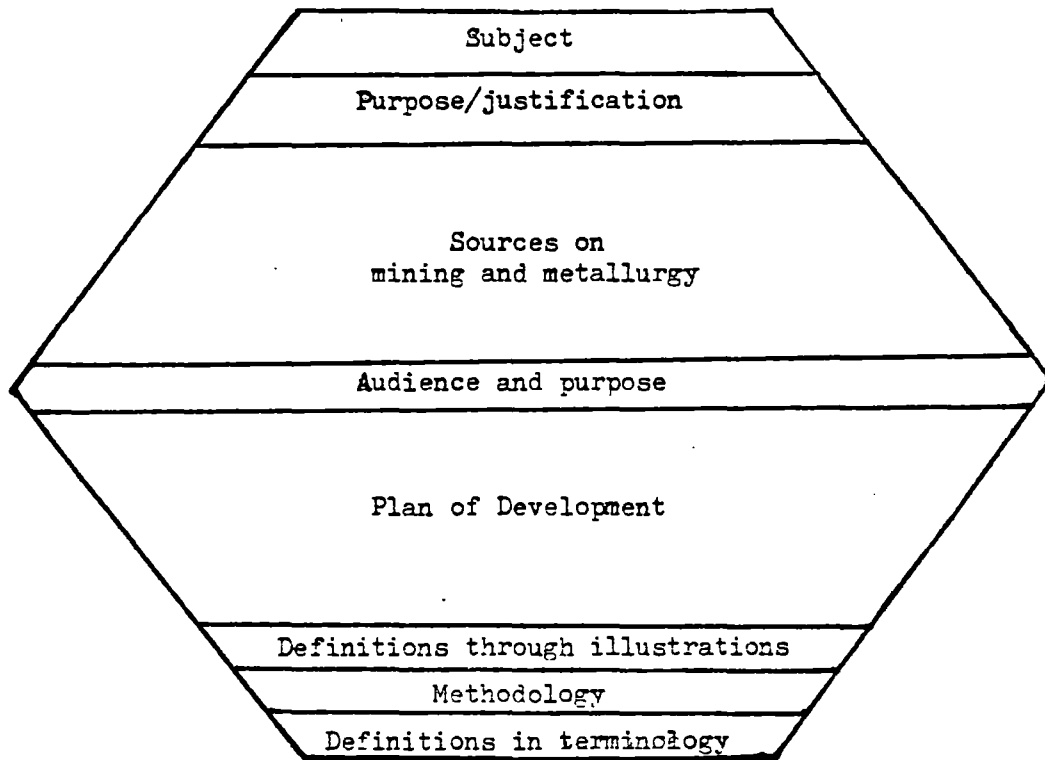
Figure 3:   Diagram of Core of "Preface"

This corpus of information—Agricola´s inclusion of information

that supports the standard technical writing introduction—allows the

reader to decide whether to continue reading.   Initial subject in-

terest, of course, is a primary factor that affects not only whether

the reader continues to read, but also affects the reader´s ability

(or, perhaps, desire) to comprehend that information.

This idea of appealing to the reader is important because readers

"pay attention to things of importance, to their own interests, to any-

thing wonderful, to anything pleasant; and hence you must give the

impression that your speech has to do with the like" (Aristotle, 224).
Throughout the "Preface" Agricola stresses the importance of mining and
metallurgy to all civilization, which acts as an ongoing justification
for De Re Metallica. This justification also sets up the rest of the
information in the "Preface" and perpetuates the reader's interest.

Finally, Agricola closes with the last piece of persuasive content
for the introduction: "Nay, if I understand anything, greater wealth
now lies hidden beneath the ground in the mountainous parts of your
territory than is visible and apparent above ground" (Hoover and
Hoover, xxxi) {20}. (Anyone who has ever held on to a ticket stub with
the hopes of winning a door prize should recognize the appeal of sug-
gested riches.) With this last bit of enticement, Agricola presents
the twelve books of De Re Metallica with its information for finding
and processing these riches underneath the ground.

Rhetorical Devices in the "Preface"

When discussing the content and organization of the "Preface," I
said that the audience is one of the writer's primary considerations.

Because the introduction to a work should help any reader (whether an
expert in the subject or a layperson) decide whether to continue read-
ing, the writer should incorporate some rhetorical devices to help the
reader understand the information and make that decision.

Because of the technical nature of most subjects in technical wri-
ting, a writer addressing a general audience (nonspecialists) may choose
to use analogies and similes as an effective technique for informing the
readers. Analogies and similes are, in fact, common strategies in techni-
cal writing. Some comparisons have even become such a popular method of

identifying or defining some technical term, condition, or process that the comparison has become almost synonymous with the technical information. For example, an array in computer terminology has so often been explained as a series of "mailboxes" where the computer stores information that many people, who may have little or no in-depth knowledge of computers and how they work, commonly visualize these mailboxes when someone mentions the term array. When these people think of the process involved in computers' sorting information, they imagine the mailroom clerk sorting mail and putting the appropriate pieces of mail into the appropriate mailboxes. One thing that comparisons allow us to do, therefore, is to visualize something concrete even though the term that calls up that image may be a nontangible abstract.

Some writers, on the other hand, deliberately omit rhetorical devices as a means of targeting their intended audience. In other words, by using technical terminology without explaining it (either straight-forwardly or with rhetorical devices), the writer immediately excludes nonspecialists from the initial pool of readers. After all, any reader can pick up any available piece of writing and start reading. That reader will probably continue to read, however, only if the material is comprehensible. (Earlier, I quoted the passage from Aristotle that stresses reader interest as a factor in continued reading [224]. Presumably, the reader either comes to the document with that interest or develops it while reading.)

With their idea of their intended audience in mind, some writers may omit rhetorical devices (or limit the incidence of using them) because of the nontechnical level of their information—making rhetorical devices, for the most part, unnecessary. Agricola uses only a few rhetorical devices in the introduction because its information is

non-technical and, therefore, easily understandable. Of the few

devices he does use, the most common is the simile, which he introduces

with either <u>ut</u>, <u>tanqua</u> (a form of <u>tamquam</u>), or <u>vel</u>, which all mean <u>like</u>

or <u>as</u>. In the first sentence of the "Preface," for instance, Agricola

uses three similes, which I have underlined for emphasis:

> . . . [O]ften have I considered the metallic arts as a whole,
>
> <u>as</u> <u>Moderatus</u> <u>Columella</u> <u>considered</u> <u>the</u> <u>agricultural</u> <u>arts</u>, just
>
> <u>as</u> <u>if</u> <u>I</u> <u>had</u> <u>been</u> <u>considering</u> <u>the</u> <u>whole</u> <u>of</u> <u>the</u> <u>human</u> <u>body</u>; and
>
> when I had perceived the various parts of the subject, <u>like</u>
>
> <u>so</u> <u>many</u> <u>members</u> <u>of</u> <u>the</u> <u>body</u>, I became afraid . . . (Hoover
>
> and Hoover, xxv) {21}.

From these similes, readers begin to assimilate, comprehend, and draw

conclusions about Agricola's <u>De</u> <u>Re</u> <u>Metallica</u>. First, readers familiar

with Columella's writing on agriculture get an immediate sense of the

intended magnitude of <u>De</u> <u>Re</u> <u>Metallica</u>: the magnitude inherent when one

considers the whole of any subject. The other two similes are

especially appropriate as they relate to Agricola's background in

medicine. His references to "the whole of the human body" and "so many

members of the body" establish the sense of intricacy involved in

mining and metallurgy. With these three similes in the opening

sentence, Agricola has not only established his subject (as described

in the "Content" portion of this chapter), but has also provided his

readers with the sense of depth and complexity involved in discussing

mining and metallurgy.

Later in the "Preface," Agricola again compares his work to

Columella's when he refers to his sources and methodology:

> Now, though the art of husbandry, which I willingly rank with
> the art of mining [in importance], appears to be divided into
> many branches, yet it is not separated into so many as this
> art of ours, nor can I teach the principles of this as easily
> as Columella did of that (Hoover and Hoover, xxvi) {22}.

Agricola's comparison helps establish the nature of De Re Metallica and
the difficulty in producing it.

In addition to using similes to explain his subject and his
writing project, Agricola uses a simile when criticizing the al-
chemists' work. He refers to the

> alchemists who do not change the substance of base metals,
> but colour them to represent gold or silver, so that they
> appear to be that which they are not, and when this
> appearance is taken from the fire, as if it were a garment
> foreign to them, they return to their own character (Hoover
> and Hoover, xxix) {23}.

This simile not only provides an image of the actual process described,
but almost personifies the elements in a Pygmalian/Galatean farce,
making the description of the procedure even more vivid for those who
have never witnessed this deception.

This simile for the alchemists' deception is important for those
unfamiliar with the alchemists' work, whether that unfamiliarity is
caused by the lack of access that Agricola's contemporaries may have
had to such work or by the procession of time that has exposed the
alchemists as either misguided or fraudulent, making their work equally
inaccessible to readers of the 1980's. Regardless of the fact, how-

ever, that Agricola's readers may not have witnessed alchemistic proce-

dures, readers know from his description and simile what went on and

can share his contempt for this group of researchers.

That Agricola was concerned about future readers' being able to

understand his message is evident in his final simile of the "Preface."

Recognizing the problems with terminology, he says he has hired illus-

trators to help clarify his subjects and terms in case "words should

either not be understood by men of our own times, or should cause

difficulty to posterity, in the same way as to us difficulty is often

caused by many names which the Ancients (because such words were fami-

liar to all of them) have handed down to us without any explanation"

(Hoover and Hoover, xxx) {24}.

This simile is important for two reasons: first, Agricola

evidently had many problems with terminology and recognized the un-

avoidable problems that subsequent generations could have with his

terminology. Second, without his concern, he probably would not have

hired illustrators, in which case much of De Re Metallica could indeed

be practically unintelligible for 20th-century readers.

As useful as comparisons are to clarify technical information,

writers need not rely solely on comparisons to achieve such clarity in

their work. Technical writers often use examples of their topics to aid

their audience's understanding. Earlier, I used an example of computer

terminology, an array, to discuss the effectiveness of comparisons when

communicating with readers less knowledgeable in a particular subject.

Agricola also uses examples to clarify his meaning in the "Preface."

Aristotle says, "Examples are best suited to deliberative

speeches, since we judge of things to come by divining from things that

have gone before" (34). Agricola first uses examples to indicate

available sources on mining and metallurgy--"things that have gone

before." In listing these sources, Agricola confirms his position as a

credible and ethical researcher, for in addition to the sources that

his readers considered well-known works in the early 1500's, Agricola

says, "Also among the authors I must include the modern writers, who-

soever they are, for no one should escape just condemnation who fails

to award due recognition to persons whose writings he uses, even very

slightly" (Hoover and Hoover, xxvii) {25}. Agricola adds to this list

of five authors a second list of three writers' works that he has read,

but he concludes that "from all these sources not one-half of the whole

body of the science of mining could be pieced together" (Hoover and

Hoover, xxvii) {26}.

These writers do, however, win some respect from Agricola, in

spite of the incompleteness of their works. Not so with the al-

chemists, many of whom Agricola also lists. The Hoovers are much

kinder in their treatment of the alchemists and discuss the list of

alchemists Agricola uses as examples:

> However polluted [alchemy] . . . may be, still the vast
>
> advance which it made by the discovery of the principal
>
> acids, alkalis, and the more common of their salts, should be
>
> constantly recognized. . . .
>
> Of the many Alchemists mentioned by Agricola little is
>
> really known, and no two critics agree as to the commonest
>
> details regarding many of them; in fact, an endless confusion
>
> springs from the negligent habit of the lesser alchemists of
>
> attributing the authorship of their writings to more esteemed
>
> members of their own ilk, such as Hermes, Osthanes, etc., not

to mention the palpable spuriousness of works under the names
of the real philosophers, such as Aristotle, Plato, or Moses,
and even of Jesus Christ (xxvii-xxviii, fn 12).

Agricola uses a third set of examples to clarify his problem with
and subsequent treatment of awkward terminology. He explains,

> . . . I have been forced by a necessity, for which I must be
> pardoned, to describe some of them [technical terms] by a
> number of words combined, and to distinguish others by new
> names,--to which latter class belong Ingestor, Discretor,
> Lotor, and Excoctor. Other things, again I have alluded to
> by old names, such as the Cisium; for when Nonius Marcellus
> wrote, this was the name of a two-wheeled vehicle, but I have
> adopted it for a small vehicle which has only one wheel . . .
> (Hoover and Hoover, xxxi) {27}.

From this information, readers develop a more accurate concept of the
various problems with terminology (not only for Agricola, but for
future translators as well). The examples also reassure readers that
Agricola does not use and define terms arbitrarily, but instead has
particular reasons for choosing particular words.

Finally, when addressing the princes at the end of the "Preface,"
Agricola uses examples of towns that owe their growth in wealth and
population to mining. These towns, Freiberg, Annaberg, Marienberg,
Schneeberg, Geyer, and Altenberg, give the princes (and other readers)
particular places that have benefitted from mining. Examples, like
similes and analogies, therefore, serve to provide concrete evidence of
information that may originally have been rather abstract.

Conclusion

From reading Agricola's "Preface," we can learn much about his
work to produce De Re Metallica. He says he has taken great pains with
his research and with attempting to insure that future generations can
understand his information. From the content, organization, and rhe-
torical devices in the "Preface" of De Re Metallica, we must conclude
that Agricola's audience, for the "Preface" at least, is a general
audience. Neither content nor organization nor rhetorical devices
preclude any reading audience from understanding his information. In
other words, any reader can leave the "Preface" with the same infor-
mation--regardless of that reader's level of knowledge about mining and
metallurgy before reading the "Preface."

Agricola's concern that his message remain clear for posterity
teaches a valuable lesson to 20th-century technical writers who, unlike
Agricola, work with disposable technology. It is no secret that much
of the highly technical data and products of our era will be common-
place (or outdated and useless) for the next generation. The rapid
development and subsequent obsolescence of technology make the written
details about that technology equally transient. The work that
Agricola produced, however, "remained the leading textbook for miners
and metallurgists for nearly two centuries" (Dibner, 25). As thorough
as De Re Metallica is, Agricola still would probably have been sur-
prised at its duration as the work on mining and metallurgy. For
whatever length of time a work serves its purpose and its audience,
therefore, the writer of that work has a continuing responsibility to
the longevity of the work's clarity and comprehensibility.

More important to the overall objective of this dissertation, how-

ever, is that Agricola has applied Aristotelian concepts to writing and then developed those concepts in such a way that he becomes a precursor to 20th-century theorists of technical writing. Agricola contributes to technical writing theory by employing the writing methods of including appropriate information to help readers decide whether to continue reading, and the clarifying methods of using rhetorical devices to assure effective communication by aiding comprehension.

NOTES

1

According to Corbett, the Renaissance brought renewed interest in classical rhetoric. He says that although the Rhetoric was not "a prominent textbook" in English schools, "the rhetoric taught in the schools was basically Aristotelian" (608).

Other schools in the Renaissance evidently emphasized the study of classical rhetoric as well, and Agricola did study in a school that offered classical rhetoric studies:

> Italy, already awake with the new classical revival, was still a busy workshop of antiquarian research, translation, study and publication, and through her the Greek and Latin Classics were only now available for wide distribution. Students from the rest of Europe, among them at a later time Agricola himself, flocked to the Italian Universities, and on their return infected their native cities with the newly-awakened learning (Hoover and Hoover, v).

2.

As they did with the introductory sentence (and elsewhere in the translation, the Hoovers divided the final sentence of the "Preface" into two sentences. The Hoovers also consistently break Agricola's information into paragraphs—a somewhat arbitrary format because Agricola only occasionally divides his information. That the Hoovers could so easily format his information into these paragraphs indicates Agricola's organizational acumen.

CHAPTER III

BOOK I AS PERSUASIVE TECHNICAL WRITING

While informing is undoubtedly the most common purpose for com-
municating, persuading is almost as common a purpose, and often, of
course, the inclusion of one form heightens the effect of the other.
Persuasion that does not also inform is rare; and information is often
persuasive—perhaps in the credibility of the information, if for no
other reason. Earlier, I defined the difference between informing and
persuading as a matter of authorial intent. If the writer wants to add
to the reader's knowledge, the writing's purpose is informative; if the
writer wants to change the reader's behavior or opinion about a sub-
ject, the writer's intent is persuasive. This definition may be a
little simplistic, but it generally helps when trying to measure the
purpose of writing as well as the success of that writing. For if the
reader does what the writer intends (does learn new information or does
change behavior or attitudes), the writer has succeeded.

Examples that illustrate the difference between informative and
persuasive writing are not always clear-cut, however, as this descrip-
tion may seem. In categorizing types of writing, some people may think
of definitions as examples of strictly informative writing and propo-
sals as persuasive (though writers must, of course, provide information
in proposals). Yet even this distinction is not always accurate, for
some definitions are, in fact, persuasive. Note, for instance, the
difference in the tone of The Random House College Dictionary's defini-

tions of <u>music</u> and <u>rock 'n' roll</u>:

> <u>music</u>: 1. the <u>art</u> of combining and regulating sounds of
> varying pitch to produce compositions <u>expressive</u> of various
> <u>ideas</u> and <u>emotions</u>. . . . 5. any <u>sweet</u>, <u>pleasing</u>, or
> <u>harmonious</u> sounds or sound . . . (879).
> <u>rock 'n' roll</u>: 1. a style of popular music marked by a
> <u>heavily</u> <u>accented</u> beat and a <u>simple</u>, <u>repetitive</u> phrase struc-
> ture. 2. a dance performed to this music, usually with
> <u>vigorous</u>, <u>exaggerated</u> movements (1142; emphasis added).

Although a discussion of any form of expression depends on individual preferences, some fans of rock 'n' roll are probably offended by the tone of this dictionary's definition of rock 'n' roll. The underlined portions of the definitions clearly show the writer's prejudices. Those more familiar with rock 'n' roll know that this form of music does not always have heavy accents nor a simple, repetitive phrase structure. While some people may argue that rock 'n' roll is not even a dance, others would certainly agree that these dances are not always vigorous or exaggerated. (Never mind the inherent implications that rock 'n' roll is not art and expresses no ideas or emotions.)

These definitions help explode one of the myths about technical writing: that it is objective writing. Unless the writer is discussing an unemotional topic (which is always a matter of perspective, of course), the writing is probably persuasive. Although some topics seem inherently marked by heated persuasion or strong emotional controversy or appeals (the value of certain religious, political, or artistic ideas, for example), in technical writing persuasion is most effective

when writers can channel their opinions into a rational defense of those opinions. (This rationality has often been misinterpreted or misconstrued as objectivity.) Even some subjects that many people consider unemotional--for example, mining and metallurgy--may become emotional if the writer's level of enthusiasm injects emotion into the discussion. This kind of enthusiasm may take one or several forms in communication. Advertised products, for instance, are appealing because clever marketing and advertising personnel have deliberately designed both the product and the advertisements for the specific purpose of appealing to targeted (or accessible) audiences.

Persuasion in writing may sell products, but most often (at least in technical writing), it sells ideas. Convincing others to accept and adopt a philosophy about a particular subject requires a keen sense of what motivates humans to confirm or change their opinions or behavior. The ability to recognize whether an audience typically responds to intellectual, ethical, emotional, financial, or some other motivating factor(s) is a primary asset for the persuasive writer.

After the writer chooses a subject and the appropriate opinion about that subject (appropriate for the purpose, that is), particular elements of persuasion come into play. The following diagram of questions generates the kind of information necessary for the analytical (or pre-writing) process of persuasive writing (see Figure 4, next page).

The first two questions about word choice and tone are extremely important in persuasive writing because they can sway the reader's opinion. For instance, The Random House College Dictionary's first definition of manipulate is "to handle, manage, or use, esp. with skill in some process of treatment or performance" (813). The two synonyms

Motivating Factor(s) for My Audience

- What <u>words</u> will best spark the response I want from these readers?

- What <u>tone</u> is most effective for these readers?

- How should I <u>organize</u> the information to strengthen my opinion?

- What kind of <u>comparisons</u> and <u>examples</u> will best clarify and support my opinion?

Figure 4: Diagram of Motivating Factors Writers Must Consider

for the word, "juggle" and "falsify," however, indicate an underlying, pejorative meaning. A writer could correctly use <u>manipulate</u> to mean <u>behaving diplomatically</u>, but the reader may interpret the meaning as <u>crafty</u>, <u>slick</u>, or <u>scheming</u>. Few people, in other words, would consider it a compliment to be called a manipulator because the negative connotations of the word far outweigh any compliment discerned in the actual definition.

The writer of persuasion is responsible for knowing the connotations of words selected for communicating a message. The writer is equally responsible for the overall tone of the writing. Tone goes beyond word choice (though the writer's choice of words is the logical first concern) because how those carefully selected words interact constitutes the overall tone. Michael Adelstein says, "Too often the writer thinks only of the words . . . written on a page, failing to realize that those words convey a mood both in what they say outright and in what may be read between the lines" (260). Sometimes, that process of carefully choosing words can make the tone of a work sound

phony or contrived; other poor choices of words or phrases ("as per your request," "in reference to," and "enclosed please find," for example) may make the writing (and, thus, the writer) seem pompous, evasive, or artificial.

As important as word choice and tone are in persuasive writing, discussing them in the context of this dissertation is, unfortunately, impossible. Because meaning and connotations of words change, arguing the effect of Agricola's choice of words would require finding out the connotations of those words in the 16th century, which even with medieval Latin dictionaries is still an arbitrary process that could not possibly produce reliable conclusions. In spite of the fact that such a discussion cannot take place here, it is nevertheless important to emphasize that considering word choice, were it possible, would invariably affect any analysis of Agricola's persuasive writing techniques. For the sake of this analysis, however, we must dismiss the issue and continue because other elements—organization and rhetorical strategies—do provide a basis for a substantial study of Agricola's persuasive writing.

Like all other aspects of persuasive writing, the organization of information should contribute to the support of the writer's argument. Current technical writing theory about persuasive writing indicates that writers should present their opinions first. The remainder of the persuasion may develop according to what Mathes and Stevenson call "structuring by rhetorical purpose":

> The first element of a report structured according to
> rhetorical purpose establishes the problem and provides the
> solution. . . . The second element of a report structured

according to rhetorical purpose establishes the criteria to

be used to evaluate the evidence. . . . The third element of

a report structured according to rhetorical purpose—usually

several segments—provides the support for the assertion. . . .

The final element of a report structured according to

rhetorical purpose restates the assertion which the report

has supported (98).[1]

Although there are certainly other ways to develop a persuasive argu-

ment, this strategy describes the basic process of arguing in technical

writing. The Aristotelian strategy for persuading differs slightly

from this strategy (which I will discuss later), and Agricola sometimes

follows the Aristotelian method and sometimes structures his argument

in accordance with Mathes and Stevenson's later established schema.

The section on "Organization" will show this distinction.

The other element of Agricola's persuasive strategies addressed in

this chapter is his use of rhetorical techniques to persuade his

audience. The following distinction in terminology becomes important

for this chapter. I continue to use the term rhetorical devices to

signify linguistic strategies, such as analogies, similes, and

examples. For persuasive strategies of developing an argument, I use

Aristotle's term topoi. The combination of the two I call rhetorical

strategies.

These distinctions are important, not only for clarity, but also

for showing the interrelationship of rhetorical devices and topoi

(which is why I include persuasive strategies here, rather than in the

"organization" section of this chapter). A simile, for example, is

persuasive only when the writer uses it within the context of a topos

because a simile, unlike a topos, is not inherently persuasive. For example, Aristotle's topos 20 says a communicator may use incentives and deterrents for doing or believing a particular thing. I may say, for instance, "John's prejudices will lead to his downfall." I have established, to some degree, an incentive for John to change his behavior or beliefs. If I add a simile, however, I can strengthen my argument: "Just like Hitler's, John's prejudices will lead to his downfall"—provided, of course, that John does not want to be like Hitler.

Another example uses a rhetorical question to strengthen an argument. In topos 24, Aristotle says that the communicator may argue "from the presence or absence of the cause to the existence or non-existence of the effect" (170). I could say then, "Because Jane doesn't want to get wet and catch pneumonia, she takes an umbrella when it rains. Why doesn't everyone carry an umbrella?" From the statement of cause and effect, followed by a rhetorical question, I have strengthened my proposition that those who do not want to get wet and catch pneumonia should carry an umbrella. Combining rhetorical devices and topoi, therefore, is an effective means of developing the initial argument and then strengthening or clarifying that argument.

In order to show how both the organization and rhetorical strategies Agricola uses in Book I help accomplish the persuasive mission of the book, I will first discuss the content of Book I—allowing my readers to construct a context for the more important discussions of organization and rhetorical strategies that follow.

Although it is not my purpose to detail all Agricola's argument here, I have provided a fairly comprehensive overview of Book I. Because the remaining discussions of organization and rhetorical strate-

gies use parts and fragments of statements (only enough to prove the point, in other words), this summary provides a context for discussing the work further.

Content of Book I

The first sentence of Book I sets up the argument for the remainder of the book as it explains the subject and prepares the reader for Agricola's rebuttal: "Many persons hold the opinion that the metal industries are fortuitous and that the occupation is one of sordid toil, and altogether a kind of business requiring not so much skill as labour" (Hoover and Hoover, 1) {28}. Knowing already that Agricola supports the mining industry, we can almost predict that the next sentence opens with but [sed], which it does: "But as for myself, when I reflect carefully upon its special points one by one, it appears to be far otherwise" (Hoover and Hoover, 1) {29}. From this sentence, readers may presume—and presume correctly—that Agricola will proceed to record his reflections on mining and metallurgy's special points and then draw conclusions that refute the beliefs held by the "many people" in the first sentence.

In developing his argument, Agricola first discusses the skills a successful miner must possess:

> For a miner must have the greatest skill in his work, that he may know first of all what mountain or hill, what valley or plain, can be prospected most profitably, or what he should leave alone; moreover, he must understand the veins, stringers and seams in the rocks. Then, he must be thoroughly familiar with the many and varied species of earths, juices,

gems, stones, marbles, rocks, metals, and compounds (Hoover
and Hoover, 1) {30}.

In addition to these basic mining skills, the miner needs some special
training in arts and sciences. Agricola explains these disciplines and
the reasons a miner should know them in eight sentences, one for each
discipline: philosophy, medicine, astronomy, surveying, arithmetical
science (business mathematics), architecture, drawing, and law (Hoover and
Hoover 3-4).

After explaining the skills and disciplines the miner should have
and know, Agricola directly states his purpose for writing this book:

> Since there has always been the greatest disagreement amongst
> men concerning mining, some praising, others utterly con-
> demning them, therefore, I have decided that before imparting
> my instruction, I should carefully weigh the facts with a
> view to discovering the truth in this matter (Hoover and
> Hoover, 4) {31}.

Here, Agricola has carefully constructed the remainder of the argument
to balance the argument of mining's opponents and its proponents. To
be more accurate, I should say that Agricola has constructed the pre-
tense of objectivity to add credibility to the persuasion. No reader
should be surprised that Agricola's conclusions support the merit of
mining and metallurgy. There are, after all, eleven more books of De
Re Metallica that instruct readers on the practices of mining and
metallurgy. Besides, Agricola has already stated his convictions about
the value of his subjects in the "Preface," as well as earlier in Book
I.

Nevertheless, he does address his opponents´ complaints about mining and metallurgy--that the mining industry

1) is profitable to neither the miner engaged in it nor those outside the practice;

2) is unstable, offering no guarantee of profit;

3) is unsafe, causing serious injuries and even death to some practitioners;

4) produces worthless products (i.e., that the "gems, metals, and other mineral products are worthless in themselves" [Hoover and Hoover, 6]) {32};

5) produces products that hold no value for the soul and body of humans;

6) ruins the fields;

7) causes greed and destruction, increasing crimes;

8) makes "swords, javelins, spears, pikes, arrows--weapons by which men are wounded, and which cause slaughter, robbery, and wars" (Hoover and Hoover, 11) {33}; and

9) violates Nature by digging out products she has intentionally concealed (Hoover and Hoover, 4-12).

Concluding this list of complaints is Agricola´s rationale for addressing them:

Several good men have been so perturbed by these tragedies that they conceive an intensely bitter hatred toward metals, and they wish absolutely that metals had never been created, or being created, that no one had ever dug them out. The more I commend the singular honesty, innocence, and goodness

of such men, the more anxious shall I be to remove utterly
and eradicate all error from their minds and to reveal the
sound view, which is that the metals are most useful to
mankind (Hoover and Hoover, 12) {34}.

After refuting all these arguments, Agricola says he will "sum up
the advantages of metals" (Hoover and Hoover, 19). First, Agricola
discusses the professionals who benefit from metals: physicians,
painters, architects, and merchants. He adds, "It is, moreover, help-
ful to those whose ambition urges them toward immortal glory, because
it yields metals from which are made coins, statues, and other monu-
ments, which, next to literary records, give men in a sense immortali-
ty" (Hoover and Hoover, 19) {35}. He concludes this part of his dis-
cussion with a series of rhetorical questions, prompting the agreement
that "In a word, man could not do without the mining industry, nor did
Divine Providence will that he should" (Hoover and Hoover, 20) {36}.

Having explained the value of mining and metallurgy, he next credits
them as honorable pursuits. This discussion is not one-sided, however,
for he recognizes that all people involved in mining and metallurgy are
not necessarily involved for honorable purposes. He discusses "some of
the wicked and sinful methods by which . . . men obtain riches from
mining" (Hoover and Hoover, 20) {37}.

After presenting these ways that men have used mining dishonor-
ably, Agricola discusses the possibilities of honorably earned wealth
for miners. By comparing miners to money-lenders, he points out that
miners "gain wealth as if it were from heaven" as opposed to the money-
lenders who gain their wealth from usurious practices (Hoover and
Hoover, 22) {38}.

Finally, he compares mining and metallurgy to several other

fields, discusses their histories and their supporters, and concludes

that "mining is a calling of peculiar dignity" and that "a careful and

diligent man can attain . . . [wealth] in no easier way than mining"

(Hoover and Hoover, 24) {39, 40}.

Organization of Book I

This section on Agricola's structuring of Book I uses Mathes and

Stevenson's analysis (quoted in the introduction to this chapter) as a

basis for the discussion. Any time Agricola's organization deviates

from Mathes and Stevenson's structure indicates where Mathes and

Stevenson deviate from Aristotle's structure. Agricola's organization

of Book I, therefore, again shows the link between Aristotle and 20th-

century theorists and their concepts of effective writing.

Establishing the Problem and Providing the Solution

The beginning of an argument, according to Mathes and Stevenson,

should include

1. A statement of the problem . . .;

2. The posing of specific technical questions or tasks
   arising out of that problem, and addressed by the techni-
   cal investigation;

3. The statement of the rhetorical purpose . . . (93).

Agricola does open the first book with the statement of the problem--

that "Many persons hold the opinion that the metal industries are

fortuitous and that the occupation is one of sordid toil, and alto-

gether a kind of business requiring not so much skill as labour"
(Hoover and Hoover, 1) {see 28}. As stated earlier, the writer´s
opinion should generally introduce the argument (Mathes and Stevenson,
117). Yet, Mathes and Stevenson recognize the value of the
Aristotelian order of presenting the opponents´ view first in certain
instances:

> We have said you should routinely arrange persuasive segments
> to move from general to particular. In certain situations,
> however, the reverse order may be more effective. Assume,
> for example, that passions have been running quite high on
> the opposing sides of a hotly debated issue--and nobody wants
> to hear any position stated but his own. In such a situation
> you might find it effective to start by reducing the sense of
> threat and hostility your opposition will feel when you state
> your conclusion (Mathes and Stevenson, 120).

One way to reduce hostility, of course, is to present the opposing
view--and present it persuasively and credibly--first. In other words,
treating the opposing views respectfully may help detonate the threat.

This suggestion is precisely Aristotle´s when he discusses how to
address a prejudiced audience:

> . . . [W]e note a difference between one who is defending a
> position and one who is attacking it. The defendant will
> deal with prejudice at the beginning; the accuser will re-
> serve such effort for the close of the speech. Nor is the
> reason for this obscure. When a defendant is about to pre-
> sent his case, he must dislodge whatever stands in his way,

and so any prejudice against him must be removed at the outset (223).

This idea of removing prejudice explains Agricola's choice for an opening sentence. Furthermore, it explains the reason for even including Book I in De Re Metallica. He may well have felt that if he did not "dislodge" his opponents' prejudices, then his opponents would probably not read the remainder of the work, and he would lose the chance to prove that mining is not an "occupation . . . of sordid toil, and altogether a kind of business requiring not so much skill as labour" (Hoover and Hoover, 1) {see 28}.

After his statement of the problem, which recognizes the opposing view and then counters with his own view, Agricola explains some of the elements of this initial conflict: that mining and metallurgy do, in fact, require a great deal of skill and knowledge. This part of the opening leads to the "statement of the rhetorical purpose, i.e., a statement of what the report is designed to do in relation to the organizational conflict and the consequent technical questions and tasks" (Mathes and Stevenson, 93). Agricola says that he will address the controversy concerning the value of mining and metallurgy in the remainder of Book I (Hoover and Hoover, 4).

The beginning of Book I, therefore, meets the criteria established by Mathes and Stevenson—it "establishes the problem and provides the solution" (98). Agricola's solution, though he has already argued against his opponents' views that mining is a task of mere labour as opposed to skill and knowledge, is to "carefully weigh the facts with a view to discovering" the true value of mining (Hoover and Hoover, 4) {see 31}.

Establishing the Criteria for Evaluating the Evidence

Mathes and Stevenson claim that the writer should state the operant principles upon which conclusions are drawn (99). Theoretically, this information should help the reader decide whether to accept the writer's conclusions. Even the omission of such information helps readers decide how much faith they want to place in the writer's results.

This part of the structure for organizing a piece of persuasive writing is noticeably absent from Aristotle's Rhetoric. Whether Aristotle does not think to include this part of establishing an argument or whether he intentionally excludes this aspect is impossible to know. Readers should remember that Aristotle's purpose is to give his readers particular strategies for convincing an audience. The element of scholarly objectivity is not one of Aristotle's concerns. It is not surprising, therefore, that Aristotle would exclude the importance of announcing the basis for drawing conclusions.

Whether a writer chooses to announce the criteria, however, becomes irrelevant in a work such as Agricola's, where readers know them by the support he gives his argument. A discussion of these elements of support comprises the next section.

Supporting the Assertion

Although Agricola does not explain the criteria for his analysis, he is consistent in the methods he chooses to support his assertions. After reading Book I, readers can easily outline the methods Agricola uses to prove his claims: examples from his own era, examples from history, examples from mythology, rhetorical devices, and numerous

quotations (primarily from literary figures, such as Horace, Virgil, and Euripides, and occasionally from philosophers, such as Socrates).

Cooper explains that, according to Aristotle, a speaker (or in Agricola's case, a writer) must know where to find support for his argument--whether that support is established from outside sources or whether it results from the logic of the writer's argument (155). Aristotle also says,

> Our speaker . . . must start out, not from any and every premise that may be regarded as true, but from opinions of a definite sort--the [actual] opinions of the judges [audience] or else the opinions of persons whose authority they accept (156; bracketed material is Cooper's).

Aristotle's statement explains two strategies Agricola has used in the first book. First, some readers may be somewhat surprised that Agricola opens Book I with a discussion of miners' skills and education, rather than opening with the true issue of Book I: the controversy over the value of mining and metallurgy. Evidently, Agricola has opted to present only an opinion "of a definite sort" (156). Second, Aristotle's emphasis on "the opinions of persons whose authority they accept" explains Agricola's copious use of quotations to support the information in Book I. Further, it suggests that literary figures and philosophers carried great weight, even in matters such as opinions about mining and metallurgy.

Many of these quotations establish the pattern of Agricola's argument, based on Aristotle's concept of enthymemes as the basic organizational pattern of persuading. Cooper explains how this process works:

"You begin with an accepted or easily acceptable truth, and proceed by easily followed steps to an acceptable conclusion" (xxvii). According to Aristotle, two types of enthymemes exist, and Agricola uses both forms:

> (1) Demonstrative Enthymemes, which prove that a thing is, or is not, so and so; and (2) Refutative Enthymemes [which controvert the Demonstrative]. . . . By the demonstrative enthymeme we draw a conclusion from consistent propositions; by the refutative we draw a conclusion from inconsistent propositions (158; brackets are Cooper's).

In other words, demonstrative enthymemes list the evidence of positive proof without recognizing opposing arguments. Refutative enthymemes, on the other hand, present both sides of the argument, then conclude which view is correct.

In addressing the arguments against mining and metallurgy, Agricola opens with the skills/knowledge response to his opponents' claims that miners are just laborers. This opening, therefore, is a refutative enthymeme. He uses his opponents' argument as sort of a topic sentence on which he builds his counterpoint—that miners need x skills and y knowledge: therefore, mining is more than just an act of labor.

Analyzing the rest of Book I as demonstrative or refutative is a more complicated task. The overall structure of Book I suggests a pattern of using the refutative enthymeme. He presents all the arguments against mining with various means of support; then he refutes those arguments in the second part of the book. In isolation, however, the development of each argument against mining is a demonstrative

enthymeme. Unfortunately, Aristotle does not say how close the refuta-
tion must be to the original premise to determine whether an enthymeme
is refutative or demonstrative. We can presume, however, that Agricola
uses this distance between his opponents´ arguments and his own as a
means of allaying the audience´s prejudices.

Aristotle gives writers (or speakers) twenty-eight methods, which
he calls topoi (topics), for proving demonstrative or refutative enthy-
memes. Although Mathes and Stevenson´s concept of structuring by
rhetorical purpose indicates that Agricola´s use of Aristotelian topoi
should be discussed here, I will discuss them in the next section on
"Rhetorical Strategies."

Restating the Assertion

According to Mathes and Stevenson, the last part of a technical
document should restate "the assertion which the report has supported"
(100). Throughout Book I, Agricola has contended that mining is,
indeed, a worthy and dignified livelihood. And throughout, he has
added the incentive of wealth as a possible bonus. Agricola pre-
dictably concludes Book I, therefore, by recapitulating the focus of
his argument:

> . . . [T]o bring this discussion to an end, inasmuch as the
> chief callings are those of the moneylender, the soldier, the
> merchant, the farmer, and the miner, I say, inasmuch as usury
> is odious, while the spoil cruelly captured from the posses-
> sions of the people innocent of wrong is wicked in the sight
> of God and man, and inasmuch as the calling of the miner
> excels in honour and dignity that of the merchant trading for

lucre, while it is not less noble though far more profitable
than agriculture, who can fail to realize that mining is a
calling of peculiar dignity? Certainly, though it is but one
of ten important and excellent methods of acquiring wealth in
an honourable way, a careful and diligent man can attain this
result in no easier way than by mining (Hoover and Hoover,
24) {41}.

Although Mathes and Stevenson claim the purpose of the conclusion
is to restate the case, Aristotle claims there are four parts of (or
purposes for) the conclusion:

(1) You must render the audience well-disposed to yourself,
and ill-disposed to your opponent; (2) you must magnify and
depreciate [make whatever favors your case seem more impor-
tant and whatever favors his case seem less]; (3) you must
put the audience into the right state of emotion; and (4)
you must refresh their memories (240; bracketed material is
Cooper's).

The first requirement means that the writer must present his point of
view as the right one, the opponents' view as the wrong one.
Agricola's comparison of miners (as valuable contributors to the
contemporary way of life) to usurers, soldiers, merchants, and farmers
(as contributing varying degrees of benefits to society) does lead the
reader to conclude with him that "mining is a calling of peculiar
dignity" (Hoover and Hoover, 24) {see 39}.

Aristotle's second suggestion is that the writer make the most of
the distinction between the two views (the good and the bad, the right

and the wrong). Again, Agricola's comparison of mining to other callings emphasizes the advantages of mining. A careful reading shows
exactly what Agricola has emphasized and what he has minimized for the
effect of his argument. He does not mention, for instance, that moneylenders provide a needed service for those desperate for money. He
only emphasizes that moneylenders are usurers--that they get tremendous
profits from the money they lend. When he mentions soldiers, he does
not credit them with protecting a nation--only with taking spoils of
war from innocent people. He makes the merchant's role of trading for
"lucre" less honorable and dignified than mining (in spite of his
constant references to how much money miners can make from mining as
evidence of the goodness of mining). And in spite of his opening the
"Preface" by stating that mining and agriculture "are at least equal
and coeval" (Hoover and Hoover, xxv) {see 17}, he concludes Book I by
saying that mining "is not less noble though far more profitable than
agriculture" (Hoover and Hoover, 24) {see 41}. Obviously, Agricola has
deliberately emphasized and minimized elements of the comparison for
his argument.

By emphasizing the value of mining, Agricola succeeds in
incorporating Aristotle's suggestion--putting "the audience into the
right state of emotion" (240). Agricola's final emphasis on the
possibilities of attaining great wealth "in no easier way than by
mining" should certainly increase the readers' emotional interest,
creating the desire to continue reading (Hoover and Hoover, 24) {see
41}.

The previous three elements of the conclusion culminate in
Aristotle's fourth element of the conclusion: refreshing the readers'

memories (240). This part of the conclusion, which is the only part that Mathes and Stevenson address, is accomplished in the final sentences of Book I.

Rhetorical Strategies in Book I

In Book I, Agricola presents both sides of the argument—those in favor of mining and those opposed to it. He develops some arguments by persuasive enthymemes and some by rhetorical devices, primarily examples. This section shows how Agricola uses enthymemes (both demonstrative and refutative), how he uses five of Aristotle's topoi, and how he incorporates rhetorical devices to strengthen or clarify the argument.

Demonstrative and refutative enthymemes occur frequently in Book I. When Agricola presents the opponents' opinion that "mining is not useful to the rest of mankind because forsooth, gems, metals, and other mineral products are worthless in themselves" (Hoover and Hoover, 6) {see 32}, he develops the argument with a demonstrative enthymeme. In other words, he presents the opposing view, but he does not counter with his own opinion:

> First, they make use of this argument: "the earth does not
> conceal and remove from our eyes those things which are
> useful and necessary to mankind, but on the contrary, like a
> beneficent and kindly mother, she yields in large abundance
> from her bounty and brings into the light of day the herbs,
> vegetables, grains, and fruits, and the trees. The minerals
> on the other hand she buried far beneath in the depth of the
> ground, therefore, they should not be sought (Hoover and
> Hoover, 6-7) {42}.

In this part of his opponents' argument, Agricola has used two sets of antitheses to strengthen the contrast between the products Nature presents in full view and those she hides beneath the earth. These antitheses are signaled by the phrases "but on the contrary" and "on the other hand." Also, Agricola uses a simile, "like a beneficent and kindly mother," to imitate the opponents' opinion that Nature is a maternal figure, graciously giving what men need and protectively hiding what they do not need.

Agricola uses several other demonstrative enthymemes that serve as proof of his opponents' views. One argument, for example, concludes "that the body has absolutely no need of the metals, so hidden in the depths of the earth and for the greater part very expensive" (Hoover and Hoover, 7) {43}. Agricola also develops the argument that mining practices ecologically destroy the fields. This argument states that "woods and groves are cut down" which kills "the beasts and birds, very many of which furnish a pleasant and agreeable food for man." All these effects result in making it difficult for men to procure "the necessaries of life." Moreover, "the destruction of timber" forces them to spend more money "in erecting buildings." Therefore, "it is clear to all that there is greater detriment from mining than the value of the metals which the mining produces" (Hoover and Hoover, 8) {44}. To support this demonstrative enthymeme, Agricola lists examples of those who have "been content with virtue, and despised metals" (Hoover and Hoover, 8-9) {45}. Then, he presents a list of people who have been endangered or killed because of their riches, proving that "again and again the metals have been the cause of destruction and ruin" (Hoover and Hoover, 9-10) {46}. After listing these who have refused

riches because they recognize the chances of destruction, Agricola
concludes the enthymeme: "Therefore, all the noblest and best despise
these riches, deservedly and with justice" (Hoover and Hoover, 10)
{47}.

Agricola presents a few more enthymemes that support his op-
ponents' arguments against mining; then he presents a refutative enthy-
meme, contrasting the good intentions of these opponents with their
lack of complete knowledge and, thus, their inevitable wrong conclu-
sions (the premise of Aristotle's topos 23):

> Several good men have been so perturbed by these tragedies
> that they conceive an intensely bitter hatred toward metals,
> and they wish absolutely that metals had never been created,
> or being created, that no one had ever dug them out. The
> more I commend the singular honestly, innocence, and goodness
> of such men, the more anxious shall I be to remove utterly
> and eradicate all error from their minds and to reveal the
> sound view, which is that the metals are most useful to
> mankind (Hoover and Hoover, 12) {see 34}.

After arguing that very few of man's accommodations could come
about without the use of metals, Agricola introduces (and also con-
cludes the argument with) a demonstrative enthymeme that summarizes the
importance of metals:

> But what need of more words? If we remove metals from the
> service of man, all methods of protecting and sustaining
> health and more carefully preserving the course of life are
> done away with. . . . [W]ill anyone be so foolish or obsti-

nate as not to allow that metals are necessary for food and

clothing and that they tend to preserve life? (Hoover and

Hoover, 14) {48}.

Later, he argues that men originally assigned value to metals

because of the problems with a bartering system: primarily, the

cumbersome nature of having to carry heavy items of value to trade for

other items (Hoover and Hoover, 17).

With another demonstrative enthymeme, Agricola says,

> The curses which are uttered against iron, copper, and lead
>
> have no weight with prudent and sensible men, because if
>
> these metals were done away with, men, as their anger swelled
>
> and their fury became unbridled, would assuredly fight like
>
> wild beasts with fists, heels, nails, and teeth (Hoover and
>
> Hoover, 17) {49}.

The simile comparing men to wild beasts is especially pertinent here

because opponents of mining have already claimed that owning metals

(whether in the form of riches or weapons) encourages the brutish

aspects of human behavior. From this appeal to "prudent and sensible

men," Agricola explains the many gruesome methods men have used to

torture and kill other men; he concludes that "From these examples we

see that it is not metals that are to be condemned, but our vices, such

as anger, cruelty, discord, passion for power, avarice, and lust"

(Hoover and Hoover, 17) {50}. Agricola uses more enthymemes in Book I,

but these previous examples should demonstrate how he combines persua-

sive enthymemes with persuasive rhetorical devices to strengthen or

clarify his arguments.

In addition to enthymemes, Agricola also uses five Aristotelian topoi for developing arguments, and he combines many of these topoi with rhetorical devices, too. Most frequently, Agricola uses Aristotle's topos 23, which "is useful for persons or causes that have fallen under odium or slanderous suspicion" (170). Aristotle continues by giving instructions for alleviating that suspicion: "Here you state the reason why the facts appear in a wrong light; for then there is something that accounts for the false impression" (170). This tactic works well for Agricola's arguments because he does not, after all, want to offend those opposed to mining—he only wants to change their minds. By presenting more information—information that shows that his opponents do not base their arguments on complete information—Agricola can counter their arguments without offense. For example, when his opponents argue that mining rarely profits anyone—that, in fact, most miners "in the end spend the most bitter and most miserable of lives"—he counters with more complete information about the miners who, indeed, do come to the sordid end his opponents describe:

> But persons who hold these views do not perceive how much a
> learned and experienced miner differs from one ignorant and
> unskilled in the art. The latter digs out the ore without
> any careful discrimination, while the former first assays and
> proves it, and when he finds the veins either too narrow and
> hard, or too wide and soft, he infers therefrom that these
> cannot be mined profitably, and so works only the approved
> ones (Hoover and Hoover, 5) {51}.

He concludes this argument with an antithetical, rhetorical question: "What wonder then if we find the incompetent miner suffers loss, while

the competent one is rewarded by an abundant return from his mining?"
(Hoover and Hoover, 5) {52}. Then Agricola presents an analogy, comparing the unskilled miner to the unskilled farmer, concluding that skill and knowledge are necessary to the success of both endeavors.

Later, Agricola uses topos 23 again to counter his opponents' argument that mining is dangerous. First, Agricola agrees with his opponents; in fact, he lists the many mishaps that can occur in mining. Giving even more credence to his opponents' point, he says, "These occurrences, I confess, are of exceeding gravity, and moreover, fraught with terror and peril, so that I should consider that metals should not be dug up at all. . . ." (Hoover and Hoover, 6). The remainder of this sentence sets up his counterpoint: " . . .if such things were to happen very frequently to the miners, or if they could not safely guard against such risks by any means" (Hoover and Hoover, 6 {53}; emphasis added). He concludes with a rhetorical question--"Who would not prefer to live rather than to possess all things, even the metals?"--that should convince the opposition that he considers their objection a serious one (Hoover and Hoover, 6) {54}. Then he presents the additional information that balances their argument:

> But since things like this rarely happen and only in so far
> as workmen are careless, they do not deter miners from
> carrying on their trade any more than it would deter a car-
> penter from his, because one of his mates has acted in-
> cautiously and lost his life by falling from a high building
> (Hoover and Hoover, 6) {55}.

Agricola evidently presumes that his readers do not object to carpentry

as an occupation; his analogy, therefore, between the possible dangers of mining and carpentry emphasizes the role of caution in both of these forms of livelihood.

A second topos that Agricola uses to develop his arguments is that of proportional results, sometimes presented in an "if [si] . . . then" schema (Aristotle, 167; topos 16). Although his opponents tend to class metals as primarily "bad" things, Agricola argues that how people choose to use metals will determine whether they are good or bad. His statements argue proportional results: "For good men employ them for good, and to them they are useful. The wicked use them badly, and to them they are harmful" (Hoover and Hoover, 18) {56}. He stresses these proportional results with a simile from Socrates: "just as wine is influenced by the cask, so the character of riches is like their possessors" (Hoover and Hoover, 18) {57}. Strengthening this argument even further, Agricola discusses the good and bad uses of four examples: wine, strength, beauty, and genius. He uses each example to show how it may work to the benefit or detriment of individuals and humanity (Hoover and Hoover, 18-19). Earlier, Agricola had already established the precept for this argument with a maxim: "Money is good for those who use it well; it brings loss and evil to those who use it ill" (Hoover and Hoover, 17) {58}.

In another instance, Agricola combines two of Aristotle's topoi, numbers 11 and 18, to counter a list of quotations arguing either the worthlessness or destructive qualities of metals. Topos 11 allows the communicator to argue on the basis of existing decisions, making quotations a viable means of revealing these decisions (Aristotle, 165). Topos 18 "depends on the fact that men do not always make the same choice on a later as on an earlier occasion, but reverse it"

(Aristotle, 168). In other words, by combining topoi 11 and 18, Agricola can show discrepancies in the quotations his opponents use to object to mining. He does, in fact, show discrepancies in two quotations, both of which he credits to Euripides. The first quotation is an existing decision that mining's opponents use: "'Works of silver and purple are of use, not for human life, but rather for Tragedians'" (Hoover and Hoover, 7) {59}.[2] As Agricola points out, however, Euripides also praises the god of wealth, saying "Plutus is the god for wise men; all else is mere folly and at the same time a deception in words" (Hoover and Hoover, 8) {60}. (One may argue that this example of combining topoi uses another topos as well: topos 6 whereby the speaker turns the opponents' argument against him. Actually, however, mining's opponents are refuted only because Agricola combines topoi 11 and 18; in other words, the refutation is the effect, rather than the cause in Agricola's argument.)

Agricola also combines topoi a little later in Book I when he argues that metals are necessary for helping to provide food and clothing. Here, he says that his opponents lack complete information—or have failed to consider the full picture—and turns their argument against them (topoi 23 and 6: Aristotle, 170 and 163). For when opponents mention that metals come from the bowels of the earth and, therefore, should not be brought up, Agricola reminds them that "the fish, which we catch, [are] hidden and concealed . . . in the water, even in the sea. Indeed, it is far stranger that man, a terrestrial animal, should search the interior of the sea than the bowels of the earth" (Hoover and Hoover, 12) {61}. He then uses a series of analogies and rhetorical questions to argue that man could not provide food

nor clothing were it not for the tools made of metals.

While mining's opponents argue against the utlity of metals for food and clothing, other opponents argue against metals on a more philosophical basis: that metals are valueless and "that every great man has been content with virtue, and despised metals" (Hoover and Hoover, 8) {see 45}. Agricola develops their contention with examples these opponents use of men who were "content with virtue"--who were, in fact, content enough to give away their riches or to leave them behind when threatened by enemies. Then, Agricola refutes their praise for these men by suggesting what these virtuous men should have done with their money. Here, Agricola follows Aristotle's advice set forth in topos 25: "See if it is or was possible to devise a better course than the speaker is recommending, or than is or was taken" (170). Although Aristotle points out that this technique is an unsound one because "it often becomes clear after the event how an affair could have been better managed, though before the event this was not clear" (170), Agricola shows no sign of excusing the decisions of these virtuous men. What follows is a quotation from Book I to show just how Agricola answers his opponents' claims that forsaking riches is a sign of virtue--and that he does not temper his refutation by granting the advantage of hindsight:

> Bias of Priene, when his country was taken, carried away out
> of the city none of his valuables. So strong a man with such
> a reputation for wisdom had no need to fear personal danger
> from the enemy, but this in truth cannot be said of him
> because he hastily took to flight; the throwing away of his
> goods does not seem to me so great a matter, for he had lost

his house, his estates, and even his country, than which

nothing is more precious. Nay, I should be convinced of

Bias's contempt and scorn for possessions of this kind, if

before his country was captured he had bestowed them freely

on relations and friends, or had distributed them to the very

poor, for this he could have done freely and without

question. Whereas his conduct, which the Greeks admire so

greatly, was due, it would seem, to his being driven out by

the enemy and stricken with fear (Hoover and Hoover, 14)

{62}.

Agricola occasionally constructs an argument without the aid of
one (or more) of Aristotle's topoi. Sometimes, he argues on the
strength of examples alone, as he does when he practically lists mytho-
logical and historical figures who were led to destroy others or else
led to their own destruction because of riches (Hoover and Hoover, 9).
Similarly, he lists the professions that benefit in one way or another
from metals, including physicians, painters, architects, merchants, and
so on (Hoover and Hoover, 19-20). He lists examples of "some of the
wicked and sinful methods by which . . . men obtain riches from mining'
(Hoover and Hoover, 20, with examples continuing through page 22) {see
37}. He also provides refutative examples to show that "if mining is a
shameful and discreditable employment for a gentleman because slaves
once worked mines," then other professions, such as agriculture, archi-
tecture, and medicine, should likewise be considered unsuitable pur-
suits for gentlemen (Hoover and Hoover, 23) {63}.

Also outside the range of Aristotelain topoi are the two occasions
on which Agricola constructs his arguments on the basis of religious

considerations. When he says he wants to enlighten the good men who have misunderstood the mining profession, his first point relies on his opponents' religious integrity:

> . . . [T]hose who speak ill of the metals and refuse to make use of them, do not see that they accuse and condemn as wicked the Creator Himself, when they assert that He fashioned somethings vainly and without good cause, and thus they regard Him as the Author of evils, which opinion is certainly not worthy of pious and sensible men (Hoover and Hoover, 12) {64}.

The second time Agricola uses religious persuasion, he is concluding his examples that show "the benefits and advantages derived from metals" (Hoover and Hoover, 20). He uses a rhetorical question to introduce the religious "proof"--a conclusion based more, perhaps, on the emotion of the moment, the fervor of the argument, and the enthusiasm of the author than on any clearly logical conclusion: "Who then does not understand how highly useful they [metals] are, nay rather, how necessary to the human race? In a word, man could not do without the mining industry, nor did Divine Providence will that he should" (Hoover and Hoover, 20) {65}. Whether Agricola recognized the dubiousness of his conclusion is, of course, impossible to know. That he does not develop the point any further may indicate his presumption that his opponents will accept his argument--or may indicate that he recognizes that this statement is, at the same time, both unprovable and unassailable. For whatever reason he chooses to leave this religious point, leave it he does--and continues with more logically debatable issues.

Agricola's methods of persuasion rely on these kinds of religious developments only twice in Book I, but both occasions give him an invaluable tool for countering his opponents' objections to mining and its products.[3] More commonly, Agricola uses Aristotelian methods of persuading his audience: through using enthymemes (demonstrative and refutative), _topoi_ (singularly and sometimes combined with each other), and rhetorical devices (primarily, rhetorical questions, analogies, similes, and, of course, examples).

Conclusion

From the lack of technical jargon and complicated rhetorical devices in Book I, we can conclude that Agricola was writing for a general audience, regardless of the readers' knowledge or lack of knowledge about mining. Just as readers should have no trouble understanding the information in the "Preface" of De Re Metallica, they should have no trouble understanding Agricola's arguments in Book I.

On this basis, it is tempting to conclude that Agricola wrote Book I for those unfamiliar with mining--those whose unfamiliarity may, in fact, have led to their opposition to mining. Such a conclusion, however, may be a faulty one because we cannot know why Agricola's readers read the first book. They may or may not have initially agreed with his argument about the value of mining.

At first, we may feel compelled to conclude that Agricola perceived the audience for Book I to be opposed to mining--otherwise, why would he have written a persuasive section arguing the value of mining? On the other hand, I suggest that we have all, at some time or another, read persuasive writing that did not have to persuade because we

already agreed with the writer's point of view. Sometimes we read to confirm our opinions, and sometimes we read to find means of strengthening our arguments against those people who disagree with us. (We plagiarize and store up information, so to speak.)

It is impossible, therefore, to conclude which view his readers held, but, most likely, he had readers from both sides of the argument. The absence of technical terminology may be evidence that Agricola presumed his readers to be opposed to mining—perhaps because they did not understand it. If so, he would naturally want to keep his writing rather simple to keep their attention. Or, he may have avoided technical terminology for the sake of those readers, already convinced of the value of mining, who wanted to use his arguments and their own—so he kept these arguments in the language that they could use when presenting their opinions to their opponents.

This analysis of the audience of Book I is, obviously, inconclusive. But even the uncertainty about Agricola's audience is important for the overall purpose for this dissertation. That Agricola could have been writing for a technical or non-technical audience, for a supportive or unsupportive audience, strengthens the value of De Re Metallica in the evolution of technical writing because his strategies of developing, organizing, and supporting his content for either audience apply Aristotelian concepts while incorporating 20th-century additions into these concepts.

NOTES

1

John C. Mathes and Dwight W. Stevenson, both professors in the
College of Engineering at The University of Michigan, have their PhDs
in English and specialize in technical writing.

2

The Hoovers use a footnote here to explain that the source of
this quotation is confused—that "the lines are assigned . . . to
Philemon, not Euripides" (7, fn 14). If Agricola has confused the
sources, his opponents may counter that he is working with conflicting
facts (Aristotle's topos 22). If, however, the confusion was one shared
by his readers—in other words, was a confusion common at least in
Agricola's time—then his argument would still have had a chance of
persuading his readers, would have had the same effect as if he had not
confused the sources.

3

We should remember that the 16th century was a time of reli-
gious fervor—with the Lutheran Reformation underway, not to mention
the religious uproar in England under Henry VIII.

CHAPTER IV

BOOK V AS TECHNICAL INSTRUCTIONS

The previous chapters on the "Preface" and Book I of De Re
Metallica show the link between Aristotelian and 20th-century concepts
and techniques for writing information and persuasion. In De Re
Metallica's Book V, Agricola instructs practitioners on "the principles
of underground mining and the art of surveying" (Hoover and Hoover,
101). To continue using De Re Metallica as a sample of the kinds of
works that link pre-16th-century philosophies of composition with 20th-
century concepts of technical writing would logically require finding a
work on how to write instructions to which Agricola may have had ac-
cess. Unfortunately, no such work seems to exist.[1] Although
Aristotle's Rhetoric includes how to write an informative introduction
and a persuasive argument, it does not include how to write instruc-
tions. Although samples of instructions existed in the 16th century on
which Agricola may have modeled his work (including the Rhetoric, which
presents instructions for public speaking), we must presume that
Agricola, like Aristotle and the many other writers of instructions
before the 20th-century, did not work from any kind of checklist or
how-to manual, but wrote instructions based on some innate sense of
composition.

Because the point of this dissertation is to prove the logical
evolution of technical writing, and because no work on writing instruc-
tions exists before the 20th century, the analysis of Book V requires a

78

different methodology from that of previous chapters. Now, rather than
the three-dimensional structure of the previous chapters (Aristotle/
Agricola/20th-century theorists), only two dimensions exist: pre-20th-
century writers who wrote instructions without the benefit of appro-
priate guidelines and 20th-century theorists who have developed ideas
(usually from their research) about how to write instructions. So far,
this dissertation has at least hinted that much of the technical wri-
ting theory of the 20th century relies on the basics established in
works such as Aristotle's Rhetoric. Agricola's De Re Metallica has
admirably served as a sample of the link between Aristotle and 20th-
century theorists. Now, however, Agricola works with no guidelines
(other than some models he may have used, of course) for writing in-
structions. If Agricola's instructions conform to any current theo-
ries, therefore, these similarities may indicate that the evolution
continues with a two-dimensional pattern (as opposed to the earlier
three-dimensional pattern) of evolution and may, in fact, lessen the
gap between the centuries of writing.

In order to evaluate 20th-century information on writing instruc-
tions, I will first discuss the nature and importance of instructions.
Next, I will synthesize the material on how to write instructions
commonly presented in technical writing textbooks as a summary of the
general knowledge available on writing instructions. Third, I will
summarize and discuss Elizabeth Harris's essay on theoretical con-
siderations of writing instructions as a strategy for analyzing Book V
of De Re Metallica. Finally, I will analyze the fifth book according
to Harris's specification of "how to" discourse.

The Nature and Importance of Instructions

Unlike informing and persuading, instructing is a mode of communication that belongs solely to the realm of technical communication. Although everyone who informs or persuades is not necessarily a technical communicator, everyone who instructs is—by the very nature of the enterprise. The instructor is bridging the gap between those who know and those who need to know.

Almost every person has some contact with instructions every day. Because instructions are so commonplace, writing instructions may seem to be the least taxing form of writing, provided the writer truly understands the task he or she is describing. In fact, however, writing instructions can be quite difficult—perhaps because many writers perceive it as a simple assignment and are, thus, deceived into nonchalance. Some tasks that many people have performed daily (and, perhaps, for years) are extremely difficult to communicate clearly in writing. How, for instance, does a writer produce instructions on tying a shoe? on driving a car? on evaluating wine?

In addition to the difficulty of instructing readers to perform some common tasks like these, writers of instructions must also consider the propriety of including or excluding certain steps—considerations that depend, ultimately, on the reader's needs. With the previous examples of instructions, for instance, must the writer state the necessary materials—a shoe with laces, a car, a glass of wine? And what about the steps included—how much knowledge can the writer presume the reader has? When, in other words, is the information incomplete and when is it insulting?

With such issues at stake with these "simple" instructions, one

can imagine the problems with complex instructions such as those
Agricola gives in Book V. Technical writing textbooks typically pro-
vide generic principles for writing instructions but often fail to put
that information into specific contexts for specific audiences. (The
next section presents these generic principles as a method for applying
generally accepted practices of writing instructions.) Of the research
available on writing instructions, Elizabeth Harris's essay "A
Theoretical Perspective on ´How To´ Discourse" thoroughly analyzes the
parts of instructions--parts which may, indeed, culminate in producing
more useable instructions.

<div align="center">Technical Writing Textbooks: Application</div>

After explaining the importance of clear instructions, most
authors of technical writing textbooks proceed to give their own
instructions for performing that task. Emphasizing clarity, these
authors typically suggest that students

- o write instructions in chronological order,
- o use active voice as often as possible,
- o use imperative mood,
- o emphasize cautions and warnings,
- o give precise measurements, and
- o use visuals to illustrate steps, when appropriate.

Finally, most authors tell students to make sure the instructions are
complete, though they do not tell students how to measure the complete-
ness of the information. Some writers tell students to ask someone
unfamiliar with the task to use the instructions to perform the task.
On the job, however, finding such a person to perform and evaluate the

instructions may be neither possible nor practical. In such cases, it is only after the instructions have been printed and distributed that the writer can measure the success or failure of the writing. Unclear instructions may cause a barrage of calls from confused consumers, and being the cause of consumer complaints rarely ingratiates a writer with management. Other consequences may be more severe—ranging from damaged equipment to injured users or even the death of the user.

Technical Writing Research: Theory

Although the relevant research on writing instructions does not always help measure or evaluate the effectiveness of a set of instructions, it does provide some insight into factors that may affect the usefulness of instructions. Though certainly not the only technical writing article on instructions, Elizabeth Harris's essay "A Theoretical Perspective on 'How To' Discourse," as the title suggests, discusses theory rather than how to write instructions as most articles and textbooks do.[2] Harris uses Charles Morris's and James Kinneavy's semiotic theories that suggest that communication is based on semantics, syntactics, and pragmatics—the forms of discourse that focus on the relationship of the sign to what it signifies, the relationship of signs to other signs, and how humans use signs, respectively (Kinneavy, 20 and 22).

One reason that a semiotic approach is such an appropriate one for discussing the instructions in Book V of De Re Metallica is that semiotic considers language and signs within the context of "the sector of behavior under consideration" (Morris, 219). For the purpose of this chapter, of course, that behavior is writing, reading, and fol-

lowing instructions in order to perform some mining-related process—to behave in a particular way to accomplish the goal.

Although semiotic is a complex theory of language and meaning, Harris uses only the basics of the three parts of semiotic (semantic, syntactic, and pragmatic discourse) to posit that instructions are a particular form of persuasive writing. Though her argument is rather circular and complicated at times, the information she presents is useful for analyzing Book V of De Re Metallica, as I will discuss later.

First, Harris discusses the semantics of instructions, looking for how instructions "'know' or 'perceive' the world" (140). In this part of her discussion, she concludes that instructions are rarely an isolated form of discourse. They typically include description, definition, process, classification, and evaluation. In fact, instructions "may exist entirely" in one or more of these rhetorical modes (144). The absence of one of these other rhetorical modes indicates that the "processes are elementary and universally understood by practitioners in the field" (143). Thus, the inclusion or exclusion of any other rhetorical mode depends on or determines the audience for whom the instructions are intended.

Second, she recognizes the various forms instructions may take— speech, writing, or display—and limits her discussion of discourse syntactics to written instructions. She defines the other aspects of discourse syntactics as "the channel, or medium, through which the signal [or message] is conveyed, and how 'parts' of the signal are put together into the whole" (141). Definitely the weakest of her essay, this section bridges the semantic-pragmatic discussion rather than presenting any real insight into discourse syntactics.

In the final section on discourse pragmatics, Harris emphasizes the chasm created when theorists attempt to classify instructions as informative (referential) or persuasive:

> Shall we say that writers and readers use "how to" discourse primarily to refer to the world . . . that is, to refer to whatever process the discourse is "about"? Or shall we say that writers and readers use "how to" discourse primarily to affect readers, to enable them to perform the task being referred to? (150).

Harris devotes the rest of her essay to the argument that instructions are "a special kind of persuasion, used primarily to effect readers' performances of tasks" (154). She continues with the implications of this persuasive purpose of "how to" discourse:

> To this end, the discourse depends mainly on logical argument, which depends on accurate statement about the world of the task. . . . Moreover, because of the discourse's use, the reader is continually in the position to verify empirically the validity of the logical arguments and the accuracy of the statements about the world. "How to" discourse is persuasion of peculiar honesty (154).

Especially useful for this dissertation are these forms of discourse Harris discusses in relation to instruction writing: semantic, syntactic, and pragmatic. Although I certainly do not intend to develop this chapter as a support for semiotic theories, I do agree with Harris that a semiotic approach to discussing a theory of instruc-

tional discourse has valuable potentials. Because the purpose of
instructions inherently requires some system of references shared by
the writer and the reader, semiotic theory appropriately establishes
the methodology of this analysis of Agricola's Book V.

I will discuss how Agricola uses the three forms of semiotic
discourse—semantics, syntactics, and pragmatics—as the basis of my
argument and the organization of this chapter on Book V. In the
section on semantic discourse, I will show how Agricola incorporates
several rhetorical modes, such as definition, description, classifica-
tion, process, and evaluation in the fifth book. The next section
addresses syntactic discourse. Although semiotic theorists use syntac-
tic discourse (the relationship between signs) in a grammatical context
(how the subject, verb, and object relate to each other), I discuss the
relationship between signs in a different way. For this discussion of
syntactic discourse, I borrow a theory from cognitive psychology: the
schema theory. This theory claims that humans process information by
sorting the information into "mailboxes" in the brain that are already
prepared to accommodate that information—much like the array discussed
in the second chapter of this dissertation. If no such mailbox exists,
the writer must provide the information and the context that will allow
the reader to create that new slot. After the mailbox or schema has
been established, the writer structures the information in such a way
that the reader has no trouble sorting and placing it within one of
those schema. Central to this part of the process—the information
processing phase—is the given-new theory of cognitive psychology:
that the way to present information is to introduce old (or already-
known) information as the given, thus establishing the appropriate
schema. Then, the writer may add the new information. The reader

should be much more readily able to accommodate and comprehend the new information because he or she already has a context in which to place it.[3] Though obviously not the same system of sign-to-sign relation-ships that semiotic theorists discuss as syntactic discourse, the cognitive psychology approach does conform to the same goal of syntac-tic discourse: evaluating the relationship between signs.

In the final part of this discussion, I will analyze the prag-matics of Book V to determine whether Agricola's instructions are more accountable to the information he presents or to the reader—whether more referential or conative. In other words, this section will focus on "the use of these interpreted signals by encoders [writers] and decoders [readers]" (Kinneavy, 22).

Semantics of Book V

As stated earlier, semiotic is an appropriate basis for discussing instructions because of its emphasis on relationships in language and corresponding behavior. The first part of a semiotic approach focuses on semantic discourse, which James Kinneavy defines in the context of semiotic as "The study of the signals of a language as having meaning in the sense of being references to reality" (22). In order to move from language to reality, the writer of instructions often uses several rhetorical modes of communication (such as definitions, descriptions, and so on). These rhetorical modes allow readers to fuse the signs (the language) with the reality or meaning (the task of each step). These modes constitute the basis for this discussion of the semantics of Book V.

<u>Description</u>

Description in technical writing often varies distinctly from
description in other forms of writing--especially from description in,
say, creative writing. Although creative writers may use technical
descriptions in their works, they often abandon technical description
in order to emphasize the essence of the thing and to evoke appropriate
emotions and responses. This difference in technical and creative
descriptions may be primarily attributable to the emphasis on concrete
language in technical descriptions as opposed to the abstract language
in creative descriptions.[4] Consider William Blake's poem "Tyger," for
instance:

> Tyger! Tyger! burning bright
>
> In the forests of the night,
>
> What immortal hand or eye
>
> Could frame thy fearful symmetry? (ll. 1-4)

These first lines evoke powerful images of a stalking beast, and I
think most readers would agree that the image, the stance, the response
is quite different from those same impressions after reading a techni-
cal description of a tiger. A technical description may include such
facts as the average weight and length of a full-grown tiger. It may
describe the physical markings of the tiger, tell what it eats, tell
where it lives, and even explain its mating habits. More than likely,
the physical description would be accompanied by a photograph or illus-
tration of a tiger--making the responses to the description less a
matter of personal responses and interpretations than what the creative
description has provided.

Although there are several descriptions in Book V of De Re
Metallica, the best use of a technical description in Book V is
Agricola's explanation of digging through the earth to get to the ore.
This description is important because it combines specifics (precise or
measurable details) with generalities (imprecise or opinionated details
or possibilities), for although technical descriptions should be as
specific as possible, the writer certainly cannot present uncertain
information as certain. This description of the layers of earth that
Agricola describes is indicative of most of his descriptions: he
describes as accurately as possible what his readers should see but is
careful to temper specific information with generalities that reflect
the possibilities of variations. In the following excerpt of this
description, the specific measures and colors are underlined once;
generalities or any information that prevents the details from being
exact are underlined twice:

> . . . [W]hen the upper layers are removed, they dig through
> rock sometimes of one kind and colour, sometimes of one kind
> but different colours, sometimes of different kinds but of
> one colour, and lastly, of different kinds and different
> colours. The thickness of rock, both of each single stratum
> and of all combined, is uncertain, for the whole of the
> strata are in some places twenty fathoms deep, in others more
> than fifty; individual strata are in some places half a foot
> thick; in others one, two, or more feet; in others, one, two,
> three or more fathoms. . . . When the soil has been
> stripped, first of all is disclosed a stratum which is red,
> but of a dull shade and of a thickness of twenty, thirty, or

five and thirty fathoms. Then there is another stratum, also

red, but of a light shade, which has usually a thickness of

about two fathoms. Beneath this is a stratum of ash-coloured

clay nearly a fathom thick. . . . (Hoover and Hoover,
5
126). {66}

This description, which lacks complicated technical terminology, shows

Agricola's concern for accuracy and clarity. The information also sug-

gests that Agricola's intended audience, at least for this part of Book

V, has little experience digging a mine, for experienced miners would

surely find this section superfluous.

Definitions

Any discussion of definitions--especially in a semiotic context--

must reconcile the problem of using language to discuss language. In

this dissertation, however, I am more concerned with the incidence of

definitions and the occasions on which Agricola uses them than the

actual language of the definitions.

Defining a word typically adheres to the following formula:

$$SPECIES = GENUS + DIFFERENTIA$$

For example, a refrigerator (species) is an electrical appliance

(genus) that keeps its contents cool (differentia). From this defini-

tion, the writer may choose to expand the definition by discussing the

term's origin or development, by describing its physical appearance, by

comparing it to some other item, or through some other means for ex-

panding a definition.

In his description of a shaft, Agricola has to define the term

tunnel, which he does via the definition formula: "Sed cuniculus est fossa subterranea in longum acta, duplo fere altior quam latior . . ." (Agricola, 71). Translated, this definition reads, "A tunnel is a subterranean ditch driven lengthwise . . ." (Hoover and Hoover, 102). Then he expands the definition with descriptions, necessary equipment, conditions, and procedures:

> A tunnel is a subterranean ditch driven lengthwise, and is nearly twice as high as it is broad, and wide enough that workmen and others may be able to pass and carry their loads. It is usually one and a quarter fathoms high, while its width is about three and three-quarters feet. Usually two workmen are required to drive it, one of whom digs out the upper and the other the lower part, and the one goes forward, while the other follows closely after. Each sits upon small boards fixed securely from the footwall to the hangingwall, or if the vein of ore is a soft one, sometimes on a wedge-shaped plank fixed on the vein itself (Hoover and Hoover, 102) {67}.

As with the previous section's example of a technical description, this definition also suggests the intended reader is not an experienced miner. And, as with other sections that exemplify a particular mode of development, this example also incorporates description as part of its explanation. The combination of modes indicates the intended audience is a general one, for as Harris says in her essay, "processes [that] are elementary and universally understood by practitioners in the field" require no such expanded explanation (143; emphasis added).

Classification and Division

Classification and division are similar in that they rely on
methods of ascertaining similarities before pointing out the dis-
tinctions within a category. (It would probably seem silly to try to
divide attributes of tractors from sheep—unless the reader knows that
both tractors and sheep fit into the category of items in the farmer's
barn.)

The distinction between classification and division, therefore,
relies on context. Agricola uses classification and division frequent-
ly in Book V—beginning with his plan of development for this book.
Here, he divides the subject of the book—"the principles of under-
ground mining and the art of surveying" (Hoover and Hoover, 101)—into
various topics:

> And so I will describe first of all the digging of shafts,
> tunnels, and drifts on venae profundae; next I will discuss
> the good indications shown by canales, by the materials which
> are dug out, and by the rocks; then I will speak of the tools
> by which veins and rocks are broken down and excavated; the
> method by which fire shatters the hard veins; and further, of
> the machines with which water is drawn from the shafts and
> air is forced into deep shafts and long tunnels, for digging
> is impeded by the inrush of the former or the failure of the
> latter; next I will deal with the two kinds of shafts, and
> with the making of them and of tunnels; and finally, I will
> describe the method of mining venae dilatatae, venae
> cumulatae and stringers (Hoover and Hoover, 101). {68}[6]

The following diagram shows that this plan of development includes four other samples of classification. (See Figure 5 below.) Further, I think the diagram graphically presents the structure of classification and division—the separation of topics within a category—in De Re Metallica and implies how this structure differs from that of definition, for classification emphasizes equal treatment of all the elements of the group or class to which these elements belong while definition treats only the pertinent elements.

<table>
<tr><td></td><td>shafts</td></tr>
<tr><td>digging in venae profundae</td><td>tunnels</td></tr>
<tr><td></td><td>drifts</td></tr>
</table>

<table>
<tr><td></td><td>materials dug out</td></tr>
<tr><td>good indications shown by canales</td><td></td></tr>
<tr><td></td><td>rocks</td></tr>
</table>

<table>
<tr><td></td><td>Type 1</td></tr>
<tr><td>shafts</td><td></td></tr>
<tr><td></td><td>Type 2</td></tr>
</table>

<table>
<tr><td></td><td>venae dilatatae</td></tr>
<tr><td>method of mining</td><td>venae cumulatae</td></tr>
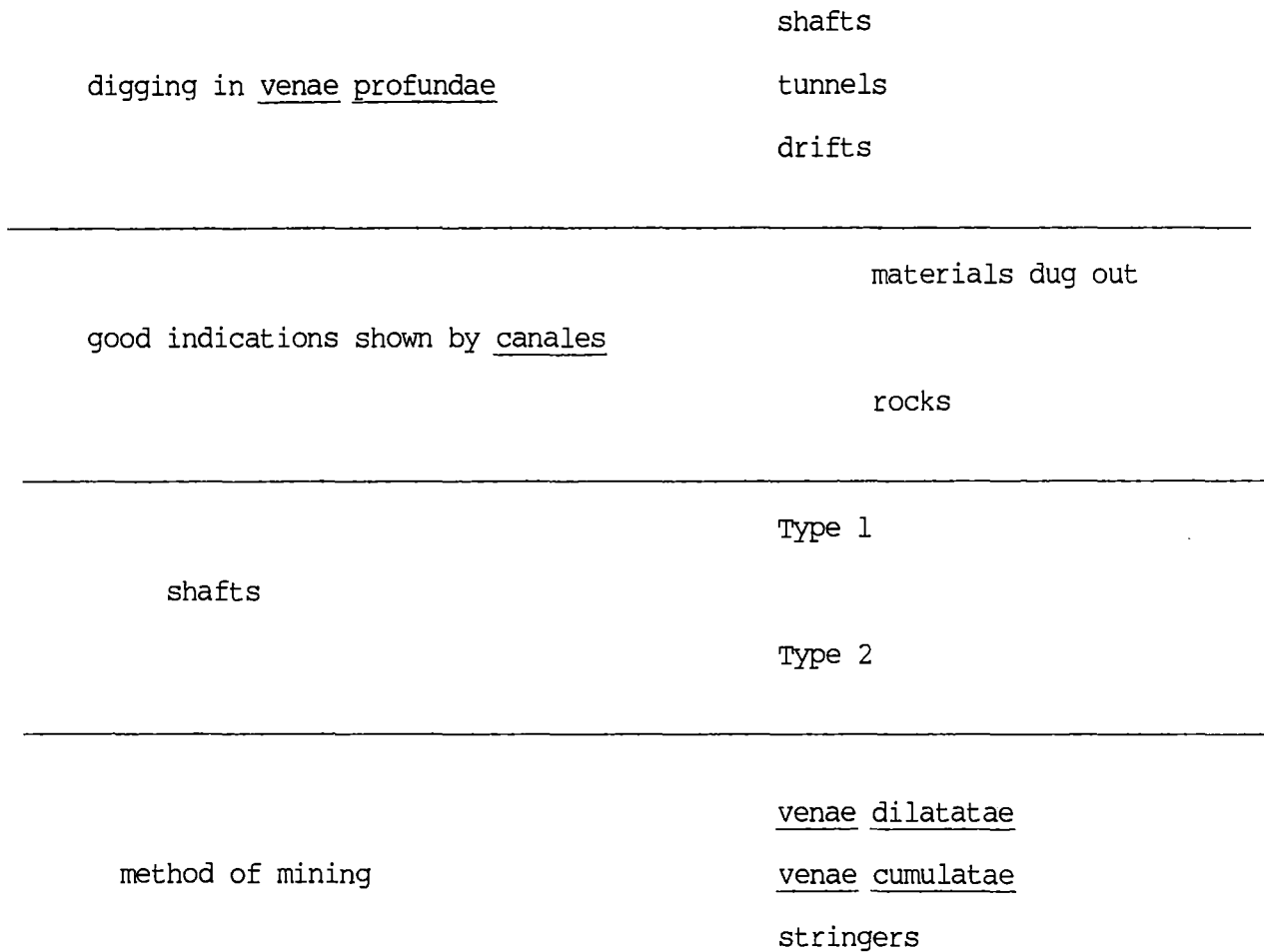<tr><td></td><td>stringers</td></tr>
</table>

Figure 5: Diagram classifying and dividing information in Book V

Process

Process explanations, as one would presume from the emphasis of this chapter, are the most frequently used rhetorical mode in Book V. Process explanations differ from instructions in the writer's intent of how the information is used. Process explanations, generally written in third person, provide readers with information for understanding; instructions, written in second person, provide readers with the steps for accomplishing (doing) the task. Obviously, because this distinction is one of how readers use information, the importance of this distinction belongs in the section on pragmatics.

This discussion of process, however, deals with the topic as a rhetorical mode. Explaining how to dig a shaft and a tunnel, for example, Agricola discusses not only the actual process, but also gives advice on what to look for, what to build where (and why), and how the miner can recognize success (a part of the evaluation mode, discussed later). Throughout his process descriptions, Agricola also uses other modes, such as description, classification, and definition.

Although digging a shaft and tunnel, as Agricola describes the process, seems a relatively uncomplicated task for even the novice miner (with the proper tools), other processes in Book V are far more complicated. That Agricola does not use other modes to simplify his information in these sections (though he does give examples of calculations) not only indicates that his intended audience for this part of the treatise is a specialized one, but also supports his statements in Book I about the miner's need for technical skills and knowledge. One part of Book V, for example, presents geometric theorems for constructing triangles in order to transfer those calculations to surveying:

When a shaft is vertical or inclined, and is sunk in the same

vein on which the tunnel is driven, there is created, as I

said, a triangle containing a right angle. Now if the minor

triangle has the two sides equal, which, in accordance with

the numbering used by surveyors, are the second and third

sides, then the second and third sides of the major triangle

will be equal; and so also the intervening distances will be

equal which lie between the mouth of the tunnel and the

bottom of the shaft, and which lie between the mouth of the

shaft and the bottom of the tunnel (Hoover and Hoover, 132)

{69}.

This quotation shows the kind of example Agricola uses to clarify theo-

ries. The terms "minor" and "major" are added by the Hoovers (132; fn

17) to shorten the distinction Agricola makes in measuring triangles

and transferring the calculations to the actual survey: "A small

triangle should be laid out, and from it calculations must be made

regarding a larger one" (Hoover and Hoover, 129) {70}.

That Agricola does not indicate minor and major triangles may

mean, of course, that he is careless in this discussion. On the other

hand, it may mean that he presumes his audience of surveyors is

familiar with this process of transferring calculations. Equally indi-

cative of the intended specialized audience is Agricola's statement

that follows his example: "Anyone with this example of proportions

will be able to construct the major and minor triangles in the same way

as I have done, if there be the necessary upright posts and cross-

beams" (Hoover and Hoover, 133) {71}. (Here, Agricola does use the

terms minor and major: minores and maiores, respectively [91].) Sure-

ly, Agricola does not believe that every miner will be able to adopt his methodology for calculating the angles of the shaft—after all, not every miner can even read. This section is intended strictly for the educated surveyor or miner with the background Agricola has specified as necessary in Book I. In fact, Agricola states after one of his complicated explanations that "the miner who is not ignorant of geometry can calculate from the other mines the depth at which the canales of a vein bearing rich metal will wind its way through the rock into his mine" (Hoover and Hoover, 117) {72}.

Other processes described in Book V demonstrate the chronological presentation of information and attention to specific details that help show why so many readers could use these descriptions as instructions. For example, the following (lengthy) passage explains how tunnels are supported:

> First, two dressed posts are erected and set into the tunnel
> floor, which is dug out a little; these are of medium thick-
> ness, and high enough that their ends, which are cut square,
> almost touch the top of the tunnel; then upon them is placed
> a smaller dressed cap, which is mortised into the heads of
> the posts; at the bottom, other small timbers, whose ends are
> similarly squared, are mortised into the posts. At each
> interval of one and a half fathoms, one of these sets is
> erected; each one of these the miners call a "little door-
> way," because it opens a certain amount of passage way; and
> indeed, when necessity requires it, doors are fixed to the
> timbers of each little doorway so that it can be closed.
> Then lagging of planks or of poles is placed upon the caps

lengthwise, so as to reach from one set of timbers to an-
other, and is laid along the sides, in case some portion of
the body of the mountain may fall, and by its bulk impede
passage or crush persons coming in or out. Moreover, to
make the timbers remain stationary, wooden pegs are driven
between them and the sides of the tunnel. Lastly, if rock or
earth are carried out in wheelbarrows, planks joined together
are laid upon the sills; if the rock is hauled out in trucks,
then two timbers three-quarters of a foot thick and wide are
laid on the sills, and, where they join, these are usually
hollowed out so that in the hollow, as in a road, the iron
pin of the truck may be pushed along; indeed, because of this
pin in the groove, the truck does not leave the worn track to
the left or right. Beneath the sills are the drains through
which the water flows away (Hoover and Hoover, 124-25) {73}.

This process explanation demonstrates the difference between technical
descriptions, which focus on the qualities or attributes or physical
appearance of a thing, and a process description, which focuses on the
order in which something happens or is made.

Other processes explained in Book V show how Agricola combines
rhetorical modes. For example, he includes how to use and read a
hemicycle, which he defines as "half a circle, the outer margin of
which is covered with wax, and within this are six semi-circular lines"
(Hoover and Hoover, 137) {74}. He also defines an _orbis_ as "an instru-
ment which has an indicator peculiar to itself" (Hoover and Hoover,
141) {75}, before explaining the process of using the instrument.

In spite of his use of definitions in his process descriptions,

these descriptions are not written for the general reader. For even

with the definitions of the instruments used in the calculations, the

reader must have some prior knowledge or familiarity with the indivi-

dual processes Agricola describes—even before being able to use the

instruments.

Evaluations

In Book V, Agricola incorporates evaluations to show the reader

when the task is successfully completed. Though perhaps not a standard

rhetorical mode, evaluation is important in process descriptions and

instructions because it shows the end of the process. (No other rhe-

torical mode requires a signal of the end of its information.) After a

lengthy explanation of the process of connecting shafts, for example,

Agricola says, "From this measurement is known in what part of the

drift or tunnel the raise should be made, and how many fathoms of vein

remain to be broken through in order that the shaft may be connected"

(Hoover and Hoover, 144-45) {76}.

Another example of Agricola's use of evaluation in the fifth book

combines evaluation with classification. Here, he uses comparisons as

the basis for the evaluation and classification:

> . . . [I]n some places the hangingwall rock is soft and
>
> fragile, in others hard, in others harder, and in still
>
> others of the hardest sort. I call that ore "crumbling"
>
> which is composed of earth, and of soft solidified juices;
>
> that ore "hard" which is composed of metallic minerals and
>
> moderately hard stones, such as for the most part are those
>
> which easily melt in a fire of the first and second orders,

like lead and similar materials. I call that ore "harder" when with those I have already mentioned are combined various sorts of quartz, or stones which easily melt in fire of the third degree, or pyrites, or cadmia, or very hard marble. I call that ore hardest, which is composed throughout the whole vein of these hard stones and compounds (Hoover and Hoover, 117) {77}.

This distinction between the general qualities of ores provides specific measure or methods of evaluating the abstract terms "hard," "harder," and "hardest."

Another method of presenting evaluations follows the "if . . . then" construction. First, Agricola presents the precedents or foundations of the topic, followed by his conclusions--his evaluations or interpretations of the "if" part of the construction. Agricola uses this construction when describing processes as in the following example: "if [si] the excavation is low, only one pile of logs is placed in it, if [si] high, there are two, one placed above the other . . . (Hoover and Hoover, 119; Agricola, 80) {78}. At other times, Agricola uses this construction to explain significance, rather than process: the heaviness of the air in the shafts and tunnels prevents miners from staying below ground for too long, "or if they do continue, they cannot breathe freely and they have headaches" (Hoover and Hoover, 121). These examples of Agricola's use of "if . . . then" constructions demonstrate his method of developing information for the reader's basis of evaluation.

From the discussion of semantic discourse--how signs (language) reflect reality--in Agricola's fifth book, we may already draw some

conclusions about Agricola's readers. First, Agricola did not intend Book V to be read by only one type of reader, for some of the information is too simple to be useful to the experienced miner, while other information is far too complicated for unexperienced miners. Fortunately for his readers, Agricola specifies the necessary skills the reader needs to understand and follow his procedures of the various mining and surveying tasks he describes. Second, because this book is intended for various audiences, we may conclude that Agricola also intended that they read the technical document much the same way as 20th-century readers read technical documents: that is, they read only the portions of the work that are either applicable to them and their work or that they can comprehend. Therefore, the work does not have to conform to one principle of information development.

Syntactic Discourse in Book V

As discussed in the introduction of this chapter, this section on syntactic discourse relies on evaluations of the use of given-new structures for presenting information. The given-new structure is especially appropriate for discussing processes and instructions because both endeavors require the presentation of information in steps. Each completed step becomes the given on which the new step is based.

The given-new strategy depends to a large extent on the use of redundancy, a concept supported in Claude Shannon and Warren Weaver's The Mathematical Theory of Communication, in which the authors use two principles to suggest a structure for presenting information; entropy and redundancy. Entropy is the random sequence of particles, whether those particles are letters of the alphabet, words in a sentence, or

sentences in a paragraph. Redundancy allows readers to incorporate
information into their schema for that kind of information—for that
context, in other words (25-6).

Shannon and Weaver's work with entropy and redundancy has given
rise to several studies and subsequent given-new theories, which sug-
gest that information is most comprehensible when writers present the
context for the information (generally referring to something they
presume their readers already know) before presenting the new informa-
tion. Of course, these studies' conclusions are really not new—nor is
the process of orienting the reader with some sort of context before
presenting the information, for such is one of the purposes for using
topic sentences (Kintsch and van Dijk, 365). But writers, including
Agricola, often use given-new methods not only to introduce informa-
tion, but to develop it as well.

Rather than the strict semiotic approach to evaluating syntactic
discourse, this dissertation focuses on the relationship between signs
in a contextual sense, rather than a grammatical sense. And this
contextual sense not only incorporates the more obvious structure of
"what I already told you" followed by "what I am telling you now," but
also includes the use of rhetorical strategies as another form of
given-new structure. In particular, these rhetorical strategies are
comparisons, whether similes or analogies, because these comparisons
rely on already-familiar knowledge as a means of explaining the new
knowledge.

Throughout Book V, Agricola presents new information by referring
to old information first. His opening sentence of Book V reads, "In
the last book I have explained the methods of delimiting the meers

along each kind of vein, and the duties of mine officials. In this book I will in like manner explain the principles of underground mining and the art of surveying" (Hoover and Hoover, 101) {80}. Then, he proceeds with his plan of development, quoted earlier in this chapter. This plan of development provides the initial context of the information in Book V.

Agricola uses the same strategy throughout Book V to move from subject to subject. After the introduction, for example, Agricola says, "I have spoken of shafts, tunnels, and drifts. I will now speak of the indications given by the canales, by the materials which are dug out, and by the rocks" (Hoover and Hoover, 106) {81}. (These announcements of what he has discussed and what he plans to discuss next are, for all practical purposes, the only sense of transition he gives his readers.)

In addition to using given-new strategies to announce his plan of development and to move from subject to subject, Agricola also uses given-new strategies for moving from sentence to sentence. The following paragraph shows a typical example of this kind of movement:

> The common miners look favourably upon the stringers which come from the north and join the main vein; on the other hand, they look unfavourably upon those which come from the south, and say that these do much harm to the main vein, while the former improve it. But I think that miners should not neglect either of them: as I showed in Book III, experience does not confirm those who hold this opinion about veins, so now again I could furnish examples of each kind of stringers rejected by the common miners which have proved

good, but I know this could be of little or no benefit to posterity (Hoover and Hoover, 106-07) {82}.

Agricola uses the first part of the first sentence to establish the given information: "The common miners look favourably upon the stringers which come from the north and join the main vein. . . ." He then sets up contrasting information with the transition "on the other hand," but he is still presenting given information because these ideas are also traditional beliefs. When he refers to Book III, where he has proven that "experience does not confirm those [miners] who hold this opinion [that stringers from the south harm the main vein] about veins . . .," he begins the new information. The old information is given as "this opinion," and the new information constitutes the remainder of the statement. The rest of the quotation is actually a given-given structure, which may be used either to summarize information or to refer to given information only. Here, Agricola refers to earlier information, saying he could recount the examples of mines that have been productive, although many miners did not care to work them because of some theory they had about north versus south stringers. He has, indeed, discussed these successful mines in Book III (Hoover and Hoover, 74-5), but he realizes that repeating the examples here would not be advantageously redundant, but merely repetitious. (Unlike redundancy, which builds information on similarities, repetition rehashes information.)

Agricola develops his new information, therefore, by using information and pronouns in a given-new structure. The pronouns in this passage--"they," "those," "these," "it," and others--contribute to the given-new structure; after all, given-new is the principle behind

pronouns and antecedents.

In addition to the use of pronouns and informational strategies, Agricola also uses rhetorical strategies that present new information by comparing that new information to well-known (or given) information. By using these comparisons, Agricola structures the information to fit the reader's schema. For example, he compares the canales of the main veins to branches of a tree (Hoover and Hoover, 107), the process of following veins or marble to that of following rocks or building stones (Hoover and Hoover, 115), and the appearance of some type of earth to burned earth (Hoover and Hoover, 116). In another example, Agricola compares the attention miners give to the quality of air in a mine to the attention they pay to digging. Within the same discussion, he compares vaporous air to "a vault or some underground chamber which has been completely closed for many years" (Hoover and Hoover, 121) {83}. This last comparison is especially useful for general readers who are probably unfamiliar with the air in a mine, but who have probably, at some time or other, been in an underground chamber, such as a basement or cellar.

Although Agricola generally uses comparisons for presenting simi-larities, sometimes he uses comparisons to establish only basic similarities before presenting how the elements differ. With these comparisons, he states that A is like B except in the following ways. The comparison is the given; the contrast is the new. For example, he says, "Miners timber drifts in the same way as tunnels. These do not, however, require sill-pieces or drains . . ." (Hoover and Hoover, 125) {84}. In another example, Agricola writes,

> Excavations of this kind were called by the Greeks
>
> for, extending along after the manner of a tunnel, they are
>
> entirely hidden within the ground. This kind of an opening,
>
> however, differs from a tunnel in that it is dark throughout
>
> its length, whereas a tunnel has a mouth open to daylight
>
> (Hoover and Hoover, 104-05) {85}.

These examples show how Agricola incorporates redundancy through given-new (and rhetorical) strategies. Like semantic discourse, the syntactic discourse of sign-sign relationships implies various levels of audiences, for the omission of a created context (or schema) for information indicates Agricola's presumption that his readers already have a context or schema for that information. Any analysis--or even a cursory reading--of Book V allows readers to see immediately that, for example, the complicated information on surveying, in which Agricola uses geometrical formulas for measuring angles that correspond to the technique for calculating the correct depth of shafts, uses no patterns of redundancy (whether given-new or rhetorical strategies). Agricola's audience for this section, therefore, must already have the appropriate schema that can accommodate this information. And like readers who need no definitions or other sematic discourse structures, these readers must be considered experienced practitioners.

Pragmatic Discourse in Book V

While semantic discourse and syntactic discourse exist as means of looking "into" language--how language bonds to form a coherent message--pragmatic discourse focuses on how humans use signs and, thus, language. Harris contends that the purpose of instructions raises an

important issue: whether the writing is referential or persuasive. As she says,

> This is an interesting question, because its answer tells us whether, when we are writing "how to" discourse, we should think more about the process we are giving instructions in, or more about the reader we are giving instructions to. Obviously, we must think about both of them. But which is primary? (150).

The chicken or the egg. If the primary concern is the subject matter, the writing is referential; if the reader is primary, the writing is persuasive. This issue is not a simple one, for the responsibility of accuracy demands responsibility to the subject and reader alike. In an effort to simplify the subject, the writer may sacrifice accuracy, which may affect the outcome of the task. Similarly, if the writer presents the instructions without educating the reader, the accuracy, and thus the outcome of the task, may again be sabotaged. The balance of referential and persuasive elements in instructions is, therefore, crucial.

In an effort to recognize this balance, Harris states that instructions are "a special kind of persuasion, one that employs the characteristic arguments of persuasive discourse in distinctive ways" (151). She qualifies instructional persuasion as "special" because she contends that the instructions "enable readers to perform tasks they have already decided to perform" (151). Surely, this contention causes questions about the "persuasive" nature of instructions. If the reader has already decided to perform some task, why should instructions have to be persuasive? Surely, we have all thought we wanted to do

something--have, in fact, <u>decided</u> to do something--only to change our minds after reading the instructions for the process. The task seems (and, perhaps, is) too complicated, too time-consuming, or does not provide the results we initially anticipated. Therefore, Harris's qualification of the persuasive nature of instructions may not be accurate because some instructions actually <u>dissuade</u> the reader from performing the task.

This discussion has important implications for the analysis of the pragmatics of <u>De Re Metallica</u>'s fifth book. To determine whether Agricola's information in Book V is referential or persuasive requires determining what he intended his readers do with the information.

As mentioned earlier, this idea of intent also distinguishes process explanations from instructions, a distinction relevant to this analysis of pragmatics. First, instructions (well-written instructions) enable the reader to duplicate the steps and accomplish the goal of whatever act is the intended goal. Process explanations, on the other hand, present information to show how something happens (how green plants photosynthesize), how something works (how a dog whistle attracts a dog's attention), or how something is made or done (how a jeweler makes a necklace). This last possibility--how something is made or done--can confuse the process/understanding versus instruction/ action distinction. For if the writer gives explicit details of, say, making a necklace, the reader may turn the process explanation into instructions and actually make the necklace, rather than just using the information to learn how necklaces are made.

The information in Book V of <u>De Re Metallica</u> is written as a process explanation; Agricola describes third-person actors and their

actions rather than instructing second-person actors and their actions. Yet we know that De Re Metallica was used as a textbook—as the source of instructions for performing the processes described. In this instance, at least, the structure of the information (its composition) has little to do with the pragmatics of what readers do with the information.

This distinction between process explanations and instructions also clarifies the problem Harris has with the pragmatics of "how to" discourse—whether that discourse's audience uses the information to understand a process or to follow steps to the completion of some task. (As mentioned earlier, this distinction between understanding and acting is the primary difference between process explanations and instructions.) Harris says that instructions—and I would add process explanations—must be both persuasive and referential (150). Her insistence that we choose "which is primary," however, forces an irrational choice; instructions and process descriptions must be equally referential and persuasive. Instructions and process explanations convince readers that "this is how to do x" or "this is how y happens or is made." For instance, the history of scientific writing is full of process explanations written by scientists who have attempted to convince readers of the truth of how some process works—how planets and stars follow the sun, how comets are formed, and how the moon affects the ocean's tides. Instructions and process explanations are also persuasive, for the writer needs the reader's faith that the information is correct. These elements of truth and correctness are the referential side of the endeavors; the believability of the writing is the persuasive side.

Because instructions and process explanations do combine referential and persuasive discourse, we must treat these modes of writing (instructions and processes) as a separate form of discourse--neither wholly referential nor wholly persuasive. We are left with "how to" discourse as its own mode of discourse. Any attempt to place "how to" discourse within the realm of either referential or persuasive discourse will always cause problems because it does not belong in either category permanently. It must always combine concern for accuracy with concern for the reader.

Agricola's structure for Book V supports this conclusion, for he uses both persuasive and referential discourse for developing his information. For example, Agricola frequently uses logic, an Aristotelian tactic of persuasion, in Book V--especially when he discusses the geometric calculations for finding the correct depth of a shaft or tunnel. During one of these complex calculations, he says he will not develop the calculation to its conclusion (the answer) because "everyone having a small knowledge of arithmetic can work it out" (Hoover and Hoover, 134) {86}. Not only is Agricola using logic within the calculations, but he is also using logic to explain why he does not continue with the lengthy description of finding the answer.

Examples of pure persuasion also exist in Book V in the form of cautions and warnings. Here, the information is clearly developed with the reader in mind. The first example is actually advice, though caution is certainly implied:

> . . . [S]ometimes when a vein is very hard it is broken by
> fire, whereby it happens that the soft pillars break up, or
> the timbers are burnt away, and the mountain by its great

weight sinks into itself, and then the shaft buildings are
swallowed up in the great subsidence. Therefore, about a
vena cumulata it is advisable to sink some shafts which are
not subject to this kind of ruin . . . (Hoover and Hoover,
128) {87}.

The second example of a caution combines persuasive and referen-
tial discourse. Here, Agricola tries to persuade surveyors to be
careful in their measurements and calculations, else the results "will
produce great errors" (Hoover and Hoover, 130) {88}. These errors
demonstrate Agricola's concern for the accuracy of his subject.

The problem, of course, with using referential and persuasive
structure to analyze writing is that we cannot know what Agricola truly
intended. His primary goal may have been to be true to his subject,
although evidence shows that his information perfectly dovetails with
the needs of a particular audience. Or his primary goal may have been
to write for the specific audience, although his information's com-
plexity stands in the way. Even as a method of analysis, therefore,
the referential/persuasive discourse argument holds little value, and
it is only when we discard these forms as the sole potentials for
instructions that we can draw any conclusions about the merit of in-
structions.

Conclusion

This semiotic analysis of De Re Metallica's fifth book is certain-
ly a departure from the previous two chapters' analyses. The inherent
problem with this analysis, of course, is whether to analyze it as
Agricola wrote it—as process description (based on semantic and syn-

tactic discourse) or as his readers used it—as instructions (based on pragmatic discourse). I have tried to avoid the distinction until the last section on pragmatics in deference to technical writing philosophy that the reader is the most important element in any technical treatise. That emphasis on readers constitutes the basis for the following conclusions.

First, the variety of information in Book V certainly suggests that Agricola was writing for various levels of readers with various degrees of specialization. The 20th-century generic technical writing principles of writing instructions give way to the more complicated theory of explaining the information (semantic discourse) structured primarily for general readers, developing the information (syntactic discourse) for almost any reader, and focusing the primary purpose of the writing (pragmatic discourse) for mining or surveying specialists.

Second, beyond its implications for audience analysis, a semiotic discussion of instruction writing requires a more substantial look at the pragmatics of this endeavor. Though it is certainly not the purpose of this chapter to dispute Elizabeth Harris's discussion of the pragmatics of "how to" discourse (her analysis is sound; her conclusion raises questions), I think that we must conclude that instructions, while they do refer to the world and do persuade readers to trust the writer and follow the steps of the task, do not belong solely to one or the other realm of discourse. Instructional discourse is its own realm because of its pragmatics—how the readers use the information. For if readers use instructions (or process descriptions) to accomplish a task and not just to understand that process, then the pragmatics of instructional discourse varies markedly from the pragmatics of referential and conative discourse.

Finally, we should return to the two-dimensional structure of the historical writers of instructions: the pre-theory writers (such as Aristotle, Agricola, and others) and the post-theory writers. This discussion, however, more appropriately belongs in the final chapter with its conclusions and implications for further research.

NOTES

1

 In this case, proving that something did not exist is a much more complicated task than proving that it did exist. From discussions with an authority in the History of Science Collection at the University of Oklahoma (Dr. Marcia Goodman), a professor in the History of Science Department at the University of Oklahoma (Dr. Thomas Smith), a classicist in the foreign language department at Oklahoma State University (Dr. Paul Epstein), and from looking through sources these authorities recommended, I must conclude that no work on how to write instructions existed in the 16th century.

 2 See, for example, Helen V. Carlson, et al. eds. _An Annotated Bibliography on Technical Writing, Editing, Graphics, and Publishing: 1966-1980_ (Washington, DC: Society for Technical Communication, 1983). Also, the earlier bibliography, Theresa A. Philler, et al. eds. _An Annotated Bibliography on Technical Writing, Editing, Graphics, and Publishing: 1950-1965_ (Washington, DC: Society of Technical Writers and Publishers; Pittsburgh, PA: Carnegie Library, 1966).

3

 For summaries of research on given-new/schema theories, see, for example, Thomas N. Huckin, "A Cognitive Approach to Readability," _New Essays in Technical and Scientific Communication: Research, Theory, Practice_, Ed. Paul V. Anderson, et al. (New York: Baywood Publishing Company, Inc., 1983), 90-108; and Lynne M. Reder, "The Role of Elaboration in the Comprehension and Rentention of Prose: A Critical Review," _Review of Educational Research_ 50 (1980): 5-53.

4

 Kenneth W. Houp and Thomas E. Pearsall include a similar com-

parison of styles for describing a begonia--though they do not specify

the styles as creative versus technical, nor do they use a creative

·description (in the sense of creative writing)--in Reporting Tehcnical

Information, 5th ed. (New York: Macmillan Publishing Company, 1984),

5.

5

    Although some readers may think that a fathom is a naturical

measurement only, The Random house College Dictionary explains that it

is "used chiefly in nautical and mining measurements" (1981 ed.; empha-

sis added).

6

    The Hoovers explain their use of the original Latin for some

terminology:

> We have found some English equivalent, more or less satisfac-
>
> tory, for practically all . . . terms, except those of
>
> weights, the varieties of veins, and a few minerals. . . .
>
> The English nomenclature to be adopted has given great diffi-
>
> culty, for various reasons; among them, that many methods and
>
> processes described have never been practised in English-
>
> speaking mining communities, and so had no representatives in
>
> our vocabulary, and we considered the introduction of German
>
> terms undesirable; other methods and processes have become
>
> obsolete and their descriptive terms with them, yet we wished
>
> to avoid the introduction of obsolete or unusual English; but
>
> of the greatest importance of all has been the necessity to
>
> avoid rigorously such modern technical terms as would imply a
>
> greater scientific understanding than the period possessed
>
> (i).

CHAPTER V

CONCLUSIONS AND IMPLICATIONS FOR FURTHER RESEARCH

This dissertation has used Agricola's De Re Metallica to prove two points: that the work itself merits recognition as a sample of historical technical writing that deserves study and that the history of technical writing has evolved into the 20th-century theories of how to produce better technical writing.

As an analysis of De Re Metallica's "Preface," Book I, and Book V, this dissertation has shown Agricola's work to be an appropriate model for technical writing based on its content, organization, and rhetorical strategies. Just as Aristotle defines the purpose for a preface or introduction and 20th-century theorists elaborate on the relevant content of an introduction, Agricola's "Preface" incorporates both concerns--the Aristotelian purpose and 20th-century theorists' content. In addition to the inclusion and structure of these elements, his use of rhetorical strategies in the "Preface" allows us to conclude that this part of De Re Metallica is particularly suited to a general audience.

Book I persuasively treats common objections and defenses of mining practices. Again, the content, organization, and rhetorical strategies balance an earlier sample of persuasive writing--the "how to" of Aristotle's Rhetoric--and current technical writing theory, using the work of J. C. Mathes and Dwight Stevenson as a sample of this persuasive theory. Whether the reader must truly be persuaded or

whether the information Agricola provides is to be reinforcement for proponents' defenses of mining is impossible to know. We can conclude, however, that the argument in Book I is also suited for a general audience—making either use of the information possible.

The analysis of Book V shows that Agricola (and his predecessors) could write effective instructions without any information on how to write instructions, because evidently no such work existed in the 16th century. Although many of the instructions in Book V are for general readers or, perhaps, novice miners, much of the information is far too complex for any reader except the expert. The complexity of some of the instructions, however, is due to the subject matter—not the lack of information for writing instructions, for Agricola has shown throughout the fifth book that he can write instructions for general readers. The complex instructions are characterized by technical terminology, which is sometimes defined though still complex without the readers' having some prior knowledge of the subject. Geometric calculations and applications also indicate a well-educated readership.

Throughout the discussions of the "Preface," Book I, and Book V, we have seen Agricola's choice of content, organization, and rhetorical strategies used for specific purposes: to inform (introduce), to persuade, and to instruct. All these elements have worked together to allow conclusions about the variety of audiences reading De Re Metallica and their various needs for information.

This dissertation has also shown the logical evolution of technical writing from early writing, represented by Aristotle's Rhetoric, to a sample of 16th-century writing, Agricola's De Re Metallica, to current technical writing theories that explain how such writing should be done. The three-dimensional versus two-dimensional structure also

shows that patterns and techniques for writing have not always been available. Yet (Aristotle's and) Agricola's instructions conform to most of the 20th-century rules devised for writing instructions. Perhaps these writers based their writing on models available to them or, perhaps, on what they had seen work with other writers' instructions. Still, these models originated without instructions for producing them—confirming, unsurprisingly, that somewhere someone wrote without guidelines, but also confirming the evolutionary nature of writing.

From this pattern of application-application-theory, we can also, perhaps, learn something about the nature of the theoretic enterprise and measure its implications for further research. Admittedly, it is somewhat unusual to apply 20th-century theory, designed for 20th-century writing, to a 16th-century work. That De Re Metallica has so easily accommodated such theory, however, is certainly a credit to Agricola's writing skills and may also indicate some historical basis for theories about writing in general.

Traditionally, we have accepted a "natural order" for theory and practice: theory precedes practice. That concept for ordering has, for example, led to the common definition—and I would say, misconception—that technology is "applied science." We have adopted the idea that science "discovers" concepts that technologists later practice or apply.

Although discussing the natures of scientific and technological endeavors would be an indefensible digression in this chapter, the conclusions are analogous to those we have chosen to accept about the enterprises of writing and theories about writing: that theories again precede practice. Not so. Beginning with an hypothesis, theories are

inherently subjective, regardless of the many techniques researchers use to attempt to insure objectivity—else, how would they even be able to frame the questions for their research? They must start with some premise or belief—some hypothesis. And often (if not always), that belief is based on prior observations of practice (or applications) and subsequent speculations. Theories are, ultimately, only summaries based on the incidence of prior successful practices with only speculative explanations for that success.

If theorists pattern their conclusions on observations of writing that works, why use theories at all? Why not use the models themselves, for the methodology of theories suggests that models may indeed be the best method for teaching writing.

That is not to say, however, that theories are not valuable—only that they have been misrepresented as holding some monopoly as methods for analyzing writing. What theory actually gives us is a language—a terminology with its own implications and set of references—a shortcut, so to speak—that allows us to discuss writing from that philosophy's approach.

This conclusion also makes it proper to apply any theory of writing to any work because, after all, theory is based on application. It does not matter, therefore, that Agricola knew nothing of given-new writing theories; the theories were based on samples of writing—and De Re Metallica certainly qualifies as a sample of writing. That is not to say that all writing lends itself to all theoretical approaches, but it does not preclude applications merely on the basis of time—when the work was produced versus when the theory originated.

If it is acceptable to apply any theory to any sample of writing, then there are also unlimited possibilities for applying 20th-century

theories to historical samples of writing. This idea of combining stylistic and historical approaches to writing has several possible applications in the technical writing classroom.

First, such an approach will combat the notion that technical writing is a modern phenomenon within the field of writing. Second, showing how the ancient, medieval, Renaissance, and other pre-20th-century writers apply 20th-century techniques and theories of writing adds legitimacy to both the historical samples and the 20th-century theories—showing how both writing and theories develop. Third, any variations between the samples and the theories have several possibilities for discussion in the classroom: from evaluating the strengths and weaknesses of each to revising the sample to match the theory or the theory to match the sample (giving students practice in revising stylistically and ideologically). Then, discussing the effects of the changes should increase students' awareness of stylistic effects and the nature of the theory-forming process.

De Re Metallica itself also holds several possibilities for further research. First, one could study the books that this dissertation excludes. Of particular interest would be a study of the stylistic discrepancies the Hoovers mention:

> . . . [T]he fact that the writing of the work extended over a period of twenty years, [sic] sufficiently explains the considerable variation in style. The technical descriptions in the later books often take the form of House-that-Jack-built sentences which have had to be at least partially broken up and the subject occasionally re-introduced (ii).

This comparison of Agricola's initial and final writing style would, perhaps, be an interesting study of the effects of the hurry Agricola felt to complete the work before he died. (He did die before the work was published [Hoover and Hoover, x].) Further, such a study may also indicate something about Agricola's process of revising his work.

Another implication for research stems from Agricola's concept of methodology and support for his information. Primarily in Book I, which is persuasion, he uses the Ancients--Virgil, Euripides, Socrates, and others--to support the views of both proponents and opponents of the mining industry. Yet in his "Preface" Agricola specifies his methodology as one based on observation--a method clearly contrary to the method of the Ancients who used argument and logic as their primary methodology. We should consider why Agricola uses the Ancients' beliefs to advance his argument when he has stated his opposition to their methodology for accumulating information. The implication, I think, is that although Agricola is charting a new methodology, he is well aware of the impact the Ancients hold in persuasion in his day, making his work a link between the ancient methodology and the "scientific methodology" that began in the 16th century and gained the support of Francis Bacon and, later, the Royal Society of London.

Another possibility for research in De Re Metallica would apply cognitive psychology's interest in how readers recall information. Although ten editions of De Re Metallica were published--suggesting that the work was accessible to miners, surveyors, and metallurgists-- surely the technicians did not carry their copies of De Re Metallica into the mines where they could follow the step-by-step instructions. As quoted in the first chapter of this dissertation, "At Potosi the priests chained it [De Re Metallica] to the altar so that the en-

gineers, who perforce had recourse to use it, might be reminded also of their religious duties" (Farrington, 34). Reason demands that at least some of the techniques described in De Re Metallica were memorized. Some cognitive psychologists have taken a great interest in how readers recall information, generally focusing on how the structure and presentation of information affects the reader's ability to remember that information.[1] Applying such theory to the instructions of De Re Metallica may well either verify or dispute some of these theories, but in either case should certainly add to the research's conclusions.

Finally, one of the most advantageous results of this dissertation is that it has allowed the inclusion of a non-English work within the scope of historical samples of technical writing that can be studied by any "student" interested in that history. To omit analyses of works because of a language barrier is to slight the rich history of technical writing and, thus, to slight our knowledge of the number of good works produced long before English became the popular language for writing. As important as working with the original language is for sound scholarship, the translations hold value of their own—provided the translation is a good one and that students know that there are inherent variations because of the language differences. (A good translation will, as far as possible, carry the original style with the content of the work.) As long as students understand that they may be analyzing the style of the translator, they can still learn basic techniques for stylistic analyses and can draw appropriate conclusions about that style—especially in terms of content and audience analysis. Opening up the history of technical writing will invariably increase the number of samples to use in the technical writing classroom while

increasing the respect for a field as ancient and dignified as any other profession.

NOTES

1

    See, for example, Walter Kintsch, et al., "Comprehension and
Recall of Text as a Function of Content Variables," Journal of Verbal
Learning and Verbal Behavior 14 (1975): 196-214. Also, Lynne M.
Reder, "The Role of Elaboration in the Comprehension and Rentention of
Prose: A Critical Review," Review of Educational Research 50 (1980):
5-53.

WORKS CITED

Adelstein, Michael. _Contemporary Business Writing_. New York: Random
    House, 1971.

Agricola, Georgius (Bauer). _De Re Metallica Libri XII: Quibus_
    _Officia, Instrumenta, Machinae. . . . _ [with] _De Animantibus_
    _Subterraneis Liber, ab Autore Recognitus. . . . _ Basel: Froben,
    1556.

Agricola, Georgius (Bauer). _De Re Metallica Libri XII: Quibus_
    _Officia, Instrumenta, Machinae. . . . _ Trans. Herbert Clark Hoover
    and Lou Henry Hoover. 1912. New York: Dover, 1950.

Aristotle. _Rhetoric_. Trans. Lane Cooper in _The Rhetoric of Aristotle:_
    _An Expanded Translation. . . . _ By Aristotle. New York: D.
    Appleton and Company, 1932.

Baker, Ray Palmer. _The Preparation of Reports: Engineering,_
    Scientific, Administrative. New York: The Ronald Press Company,
    1924.

Blake, William. "The Tyger." _English Romantic Writers_. Ed. David
    Perkins. New York: Harcourt, 1967. 58-9.

Brockmann, John R. "Bibliography of Articles on the History of
    Technical Writing." _Journal of Technical Writing and Communica-_
    tion 13 (1983): 155-65.

Carlson, Helen V., et al., eds. _An Annotated Bibliography on Technical_
    Writing, Editing, and Publishing: 1966-1980. Washington, D. C.:
    Society for Technical Communication, 1983.

Corbett, Edward P. J. _Classical Rhetoric for the Modern Reader_. 2nd

ed. New York: Oxford UP, 1971.

Dibner, Bern. Agricola on Metals. Norwalk, CT: Burndy Library,
1958.

Farrington, Benjamin. The Philosophy of Francis Bacon: An Essay on
Its Development from 1603 to 1609 with New Translations of Funda-
mental Texts. Liverpool: Liverpool UP, 1964.

"Fathom," "Manipulate," "Music," "Rock ´N´ Roll." The Random House
College Dictionary. 1981 ed.

Gordon, Ian A. The Movement of English Prose. Bloomington:
Indiana UP, 1966.

Harris, Elizabeth. "A Theoretical Perspective on ´How To´ Discourse."
New Essays in Technical and Scientific Communication: Research,
Theory, Practice. Ed. Paul V. Anderson, et al. New York: Bay-
wood Publishing Company, Inc., 1983. 139-55.

Hoover, Herbert Clark, and Lou Henry Hoover. Translators´ Preface and
Introduction. De Re Metallica. By Georgius (Bauer) Agricola.
New York: Dover, 1950.

Houp, Kenneth, and Thomas E. Pearsall. Reporting Technical
Information. 5th ed. New York: Macmillan Publishing Company,
1984.

Huckin, Thomas N. "A Cognitive Approach to Readability." New Essays
in Technical and Scientific Communication: Research, Theory, Prac-
tice. Ed. Paul V. Anderson, et al. New York: Baywood Publishing
Company, Inc., 1983. 90-108.

Kidd, D. A. Latin-English: English-Latin. 1957. London: William
Collins Sons & Co. Ltd., 1982.

Kinneavy, James. A Theory of Discourse: Aims of Discourse. New

York: Norton, 1971.

Kintsch, Walter, et al. "Comprehension and Recall of Text as a
Function of Content Variables." Journal of Verbal Learning and
Verbal Behavior. 14 (1975): 196-214.

Kintsch, Walter, and Teun A. van Dijk. "Toward a Model of Text Compre-
hension and Production." Psychological Review 85 (1978): 363-94.

Latham, R. E. Revised Medieval Latin Word List: From British and
Irish Sources. London: Oxford UP, 1965.

Mathes, John C., and Dwight Stevenson. Designing Technical Reports:
Writing for Audiences in Organizations. Indianapolis: The Bobbs-
Merrill Company, Inc., 1976.

Miller, Walter J., and Leo E. A. Saidla, eds. Engineers as Writers:
Growth of a Literature. New York: D. Van Nostrand Company, Inc.,
1953.

Moran, Michael G., and Debra Journet, eds. Research in Technical
Communication: A Bibliographic Sourcebook. Westport, CT: Green-
wood Press, 1985. 26-8.

Morris, Charles W. Signs, Language, and Behavior. Englewood Cliffs,
NJ: Prentice, 1946.

Pearsall, Thomas, et al. Academic Programs in Technical Communication.
Washington, DC: Society for Technical Communication, 1981 and 1985
vols.

Pei, Mario. The Story of Language. New York: NAL, 1965.

Philler, Theresa A., et al., eds. An Annotated Bibliography on Tech-
nical Writing, Editing, Graphics, and Publishing: 1950-1965.
Washington, D. C.: Society of Technical Writers and Publishers;
Pittsburgh, PA: Carnegie Library, 1966.

Reder, Lynne M. "The Role of Elaboration in the Comprehension and

Retention of Prose: A Critical Review." Review of Educational

Research 50 (1980): 5-53.

Schmelzer, Richard. "The First Textbook on Technical Writing."

Journal of Technical Writing and Communication 7 (1977):

51-4.

Shannon, Claude, and Warren Weaver. The Mathematical Theory of

Communication. Urbana, IL: U of Illinois P, 1949.

APPENDIX A: LATIN PASSAGES QUOTED IN THE TEXT

This appendix provides Agricola's Latin for the English passages noted in the text of the dissertation. The numbers in {} correspond to the numbered passages in the text; the numbers in [] contain the page references to the 1556 edition of De Re Metallica.

{1} "in hoc exponam praecepta venae similiter cuiusque fodiendae, & artem mensorum" [70].

{2} "ILLUSTRISS ET POTENTISS SAXONIAE DUCIBUS LANDgravius Toringiae, Marchionibus Misenae, Comitibus Palatinis Saxoniae, Burggravius Aldeburgi & Magdeburgi, Comitibus Brenae, dominis terrae Pleisensis, MAURICIO sacri Imperius Archimarschalco & Electori, atque eius fratri AUGUSTO" [ii].

{3} "quod vobis metalla sint fructuosissima" [v].

{4} "quoniam eam integram nulli seriptores literis mandarunt, ac extera nationes & gentes nostram linguam non intelligunt, & si eam intelligerent, exiguam artis partem ex nostris istis scriptoribus pos-sunt discere, hos duodecim libros De re metallica conscripsi" [iv].

{5} "Cum seapenumero . . . totius rei Metallicae . . . magnitudinem, tanqua alicuius corporis granditate, cosiderassem: vel singulas cuis partes, quasi illius corporis membra, numerado percensuissem: veritus sum, ne vita prius me deficeret, quam universam percipere possem, nedum literis cosecrare" [ii].

{6} "nam quam longe lateque haec pateat, quot & quantarum artium, si non magna, at aliquantula cognitio metallicis ad eam tractadam

necessaria sit, ex his nostris libris quiseque intelliget" [ii].

{7} "Tamen quia veterrima est, & hominu generi maxime necessaria, atque fructuosissima, non debere a nobis negligi videbatur" [ii]. (Readers will note that the Hoovers changed this passive voice construction into active voice in their translation. Because such changes do not affect the content, I will omit further notices of insignificant alterations.)

{8} "qui tamen perpaucus rationes venarum effodiendarum, & metallorum conficiendorum exponit" [iii].

{9} "res enim metallica tantum abest, ut universa sit tractata ab aliquo scriptore ut ne ius quidem, qui desperse scripserunt alius alia de re, singulas eius partes absolverin quinetiam eorum magna est paucitas" [iii].

{10} "sed ut ea fuerit scriptorum indiligentia, ut nomina magistroru, qui ex hoc opficio magnam pecunia consecuti sunt, memoriae non tradiderint, certe discipuli decreta eorum vel non-cognoseunt, vel cognita non servant. Nam si ea perciperent, cum tam multi fuerint, & sint, oppida iamdiu auro & argento replevissent: quorum vanitatem etiam libri declarant in quibus Platonis & Aristotelis aliorumque philosophorum nomina inseribunt, ut istae gloriosae inscriptiones specie doctrinae viris simplicibus imponant" [iv].

{11} "PRIMUS habet quae cotra hanc arte & metalla atque metallicos, vel ab iusdem dici possunt. SECUNDUS metallicu informat, & in sermonem qui haberi solet de venis inveniendis, dilabitur. TERTIUS est de venis & fibris, corumque comissuris. QUARTUS explicat rationem dimetiendi venas, atque etiam expromit officia metallica. QUINTUS fossionem venaru, & artem mensoris docet. SEXTUS describit instrumeta & machinas metallicas. SEPTIMUS est de experimeto venarum. OCTAVUS praecipit de

opificio venae urendae, contundendae, lauadae, torrendae. NONUS

excoquendaru venarum ratione exponit. DECIMUS rei metallicae studiosos

instruit ad munis discernendi argentum ab auro, atque plumbium ab codem

& argento. UNDECIMUS gradit vias separandi argentum ab aete.

DUODECIMUS dat praecepta conficiendi salis, nitri, aluminis, atramenti

sutom, sulfuris, bituminis, vitri" [iv-v].

{12} "nam in eo multum operae & laboris insumpsi, aliquem etiam sumptum

impendi: etinem venas, instrumenta, vasa, canales, machinas, fornaces,

non modo descripsi, sed etiam mercede conduxi pictores ad earum

effigies exprimedas: ne res , quae verbis significantur, ignotae aut

huius aetatis hominibus, aut posteris percipiendi difficultatem

afferant: ut nobis non pauca vocabula affere solent, quae veteres

(quia res erat omnibus notae) nuda ab enodatione prodiderunt" [v].

{13} "sed sit sane id a me praetermissum, quod nec ipse vidi, neque

legi, nec ex hominibus fide dignis cognovi: id profecto quod no vel

vidi, vel lectu aut auditum expendi, non est scriptum: sive vero

praecipio ea, quae fieri debeant, sive narro, quae fieri soleant, nec

quae siunt improbo, eadem docendi ratio censeri debet" [v].

{14} "interdum nominibus carent, vel quod novae sint, vel quod, etiamsi

veteres, nominum, quibus vocabantur, memoria interierit" [v].

{15} "quare necessitate, cui venia datur, coactus quasda significavi

pluribus verbis coiunctis, quasdam notavi novis . . . quasdam veteribus

verbis designavi . . . quae nomina si quis non probaurit, is rebus

istis aut imponat magis propria, aut proferat veterum literis usitata"

[v].

{16} "ne vita prius me deficeret, quam universam percipere possem,

nedum literis cosecrare" [ll].

{17} "vel saltem aequalis & coaeva: nemo enim omnium mortalium unqua absque instrumentis agrum coluit" [ii].

{18} "Certe una fodina saepe multo maiores utilitatis fructus nobis praebet, quam agri plurimi: quocirca ex omnium fere seculorum memoria cognoseimus; complures ex metallis divites factos esse, & eadem multoru regum fortunas amplificasse" [ii].

{19} "Hi autem libri, principes illustrissimi, multis de causis in vestro nomine apparent, sed maxime quod vobis metalla sint fructuosissima: na cum maiores vestri ex amplis earum & divitibus regionibus uberes redituum fructus ceperint: item vectigalium, quae peregrini ex uns pensitant, incolae ex decumis: tamen multo uberiores ex metallis ceperunt, ex quibus quoque non pauca oppida nobilia orta sunt, Fribergum scilicet, Annebergum, Mariebergum, Snebergum, Gairu, Aldebergum, ut alia omittam: quin, si quid egosentio, maiores divitiae nunc etiam in montosis vestraru regionum lotis sub terra latent, quam supra terra existant & appareant" [v].

{20} "quin, si quid egosentio, maiores divitiae nunc etiam in montosis vestraru regionum lotis sub terra latent, quam supra terra existant & appareant" [v].

{21} "Cum saepenumero . . . totius rei Metallicae, ut Moderatus Columella Rusticae, magnitudinem, tanqua alicuius corporis gran ditate, cosiderassem: vel singulas eius partes, quasi illius corporis membra" [ii].

{22} "Quanqua aut res rustica, cum qua metallicam libenter confero, varie videtur esse diffusa, tamen in multo plures, quam haec nostra, partes no distribuitur: nec tam facile praecepta huius a me tradi possunt, quam Columella illius tradidit" [ii].

{23} "tanqua aliena veste"

{24} "ne res, quae verbis signicantur, ignotae aut huius aetatis

hominibus, aut posteris percipiendi difficultatem afferant: ut nobis

non pauca vocabula affere solent, quae veteres (quia res erat omnibus

notae) nuda ab enodatione prodiderunt" [v].

{25} "quibus novos scriptores, qualescunque sint, oportet annumerare:

nemo enim iusta reprehensione poterit carere, qui eos, quorum scriptis,

etsi paucis, utitur, debita laude fraudat" [iii].

{26} "ex his partibus non dimidium artis metallicae corpus confici

posset" [iii].

{27} "quare necessitate, cui venia datur, coactus quasda significavi

pluribus verbis coiunctis, quasdam notavi novis, quod genus sunt,

ingestor, discretor, lotor, excoctor: quasdam veteribus verbis

designavi, quale est cisium. Etenim cum Nonius Marcellus seribat,

vehiculi biroti genus esse: eo vocabulo nominare cosuevi parvum

vehiculum, cui unica est rotula" [v].

{28} "Multi habent hanc opinionen, rem metallicam fortuitum quiddam

essem & sordidum opus, atque omnino eiusmodi negotiu quod non tam artis

indigeat quam laboris" [1]

{29} "Sed mihi, cum singulas eius partes amino, & cogitatione percurro,

{24} "ne res, quae verbis signicantur, ignotae aut huius aetatis

hominibus, aut posteris percipiendi difficultatem afferant: ut nobis

non pauca vocabula affere solent, quae veteres (quia res erat omnibus

notae) nuda ab enodatione prodiderunt" [v].

{25} "quibus novos scriptores, qualescunque sint, oportet annumerare:

nemo enim iusta reprehensione poterit carere, qui eos, quorum scriptis,

etsi paucis, utitur, debita laude fraudat" [iii].

{26} "ex his partibus non dimidium artis metallicae corpus confici

posset" [iii].

{27} "quare necessitate, cui venia datur, coactus quasda significavi

pluribus verbis coiunctis, quasdam notavi novis, quod genus sunt,

ingestor, discretor, lotor, excoctor: quasdam veteribus verbis

designavi, quale est cisium. Etenim cum Nonius Marcellus seribat,

vehiculi biroti genus esse: eo vocabulo nominare cosuevi parvum

vehiculum, cui unica est rotula" [v].

{28} "Multi habent hanc opinionen, rem metallicam fortuitum quiddam

essem & sordidum opus, atque omnino eiusmodi negotiu quod non tam artis

indigeat quam laboris" [l]

{29} "Sed mihi, cum singulas eius partes amino, & cogitatione percurro,

res videtur longe aliter se habere" [l].

{30} "Siquidem metallicus sit oportet suae artis peritissimus, ut primo

sciat, qui mons, qui collis, quaeve vallestris aut campestris positio,

utiliter fodi possit, aut recuset fossionem. Deinde venae, fibrae,

commissuraeque saxorum ipsi pateant. Mox pernoseat multiplices

variasque species terraru, succorum, gemmarum, lapidum, marinoru,

saxorum, metallorum, mistorum" [l].

{31} "Cum semper fuerit inter homines summa de metallis dissensio, quod

alius eis prae coniu tribuerent, alius ea graviter vituperarent, visum

mihi est, antequam metallica praecepta tradem, veritatis investigandae

causa remipsam diligenter expendere" [2].

{32} "quia scilicet metalla & gemmae, & reliqua fossilum genera ipsis

inutilia sint" [3].

{33} "gladius, pila, hastae, conti, sagittae, quibus homines

vulnerantur, & caedes, latrocinia, bella fiunt" [7].

{34} "Istis autem tragoedius viri boni complures ita perturbatur, ut

odium acer bissimum in metalla concipiant, eaque prorsus non gigni

velint, aut genita a nemine omnium effodi. Sed quo magis singularem

illorum integritatem & innocentiam bonitatemque laudo, eo maiori curae

mihi erit, ut omnis error ex eorum animis extirpetur, ac funditus

tollatur, utque aperiatur sententia vera, & humano generi perutilis"

[8].

{35} "Utilis praeterea est ius, quoru animus ad immortalem gloriam

nititur. Nam effodit metalla, e quibus nummi & statuae aliaque fiunt,

quae post literaru monumenta hominibus quodammado [quodam modo]

aeternitate, immortalitatemque donant" [15].

{36} "Homo metallica carere non potuit, nec ipsum ea carere voluit

divina benignitas" [15].

{37} "improbus rationibus homines ex fodinis divites fieri aiunt" [15].

{38} "habebit in eum ad quem opes quasi divinitus . . . sunt" [17].

{39} "metallicam inprimus esse honestam" [18].

{40} "id homo studiosus & diligens rei familiaris non alia ratione

facilius quam metallica potest assequi" [18].

{41} "Verum ut tamdem huic disputationi sinem faciam: cum quaestus

maximi sint foeneratoris, bellatoris, mercatoris, agricolae, metallici:

foenus autem sit odiosum, praeda crudeliter capta ex fortunis plebis,

non culpa calamitosae, impia, quaestus metallici honestate ac decore

praestet mereatoris lucro: non minus sit bonus quam agricolae, multo

uberior. Quis non intelligit metallicam inprimus esse honestam: Certe

cum una sit ex decem maximus rebus optimisque, pecunia magna bono modo

invenire, id homo studiosus & diligens rei familiaris non alia ratione

facilius quam metallica potest assequi" [18].

{42} "primo his argumetis. Terra non occultat & ab oculis removet ea

quae hominu generi utilia sunt & necessaria, sed ut benefica benignaque

mater maxima largitate fundit ex sese, & in aspectum lucemque profert

herbas, legumina, fruges, fructus arboru: at fossilia in profundo

penitus abstrudit, erunda igitur non sunt" [4].

{43} "ut nihil prorsus ipsi opus sit metallis penitus in terra abditis

& maxia ex parte preciosis" [4].

{44} "Haec praeterea premunt argumenta, metalloru fossionibus agri

vastatur, quo circa quondam Italiae cautu est lege, ne quis metalloru

causa terram foderet, & agros illos uberrimos, ac vineta olivetaque

corruperet, sylvae & nemora succiduntur, nam lignis infinitis opus est

ad substructioes, ad machinas, ad metalla excoquenda. Sylvius autem &

nemoribus succisis exterminantur volucres & bestiae, quaru pleraeque

homini cibus sunt lautus & suavis. Venae metallicae lavantur, quae

lotura, quia venenis inficit rivos & fluvios, pisces aut necat, aut ex

eis abigit. Cum igitur incolae regionum propter agrorum, sylvarum,

nemorum, rivorum, fluminu vastitatem incurrant in magam difficultatem

rerum, quae suppeditant ad victum, parandarum: propter lignorum inopia

maiorem impensam faciant in aedificia extruenda, palam ante oculos

omniu est, plus in fossione detrimenti esse, quam in metallis

emolumenti, quae fossione pariutur" [5].

{45} "contra metalla clamant, praestatissimu quenque virum virtutibus cotentum ea neglexisse" [5].

{46} "quamobrem utrisque saepenuero causa interitus & exitius fuerunt" [6].

{47} "Optimus igitur quisque ista merito ac iure contemnit, & pro nihilo ducit" [7].

{48} "Sed quid pluribus verbis opus est. Metallis ex usu hominum sublatis, tollitur omnis ratio & tuendae sustentandaeque valetudinis, & tenendi cursum vitae cultioris. . . . adeone quisquam erit stultus aut pertinax, ut metalla ad victum vestitumque necessaria esse, & ad vitam hominu pertinere, non concedat" [10].

{49} "Deinde maledicta quae dicuntur in ferrum, aes, plumbum, ne ipsa quidem apud viros prudentes & graves locum habent. Etenim ut illa metalla tollatur de medio, homines certe vehementius effervescentes iracundia, & effrenato re incitati, pugnis, calcibus, unguibus, dentibus tanquam ferae certabunt" [13].

{50} "Itaque ex his intelligimus non metalla esse culpanda, sed nostra vitia, iram dico, crudelitate, discordiam, cupidatatem late regnadi, avaritiam, libidinem" [13].

{51} "Verum isti non vident quantu distet doctus & usu peritus metallicus ab artis ignaro atque imperito, hic sine ullo delectu & discrimine fodit venas, ille eas experitur atque tentat: Sed quia invenit vel nimis angustas & duras, vel laxas & putres, ex eo colligit ipsas utiliter fodi non posse; itque fodit selectas tantum" [2].

{52} "quid igitur mirum: rerum metallicaru imperitum damnum facere. peritum vero fructus ex fossione capere uberrimos" [2].

{53} "Haec quidem fateor perqua gravia esse atque adeo plena terroris & periculi, ut ipsorum vitandoru causa censerem metalla fodieda non esse,

si vel saepius in ea incurrerent metalloru fossores, vel ab eis sibi
nulla ratioe cavere possent" [3]

{54} "Qui enim non potior esset vivendi ratio, quam vel universa
possidedi, nedum metalla" [3].

{55} "Cum autem raro eiusmodi accidant, & improvidis duntaxat
fossoribus, metallicos non absterrent a fossione metalloru, ut nec a
suo artificio fabros materiarios absterret unus aliquis ex ipsis, qui,
quia incaute egit, ab alto aedificio delapsus anima efflavit" [3].

{56} "Etenim boni viri his bene ututur, eisque sunt utiles: mali,
male, eisque inutiles sunt" [13].

{57} "vinu ad vasa mutari, divitias ad eorum, qui ipsas porsident
mores" [13}.

{58} "Hic pecunia est bono, qui ea bene utuntur: dat damnum aut malum,
qui male" [12].

{59} "Non opera sunt argentea atque purpura Vitae hominum, sed magis
tragoedis usui" [4].

{60} "Plutus deus sapientibus, sunt caetera Nugae simulque verborum
praestigiae" [5].

{61} "pisces . . . quos occultos & latentes in aquis, marinas etiam,
capimus, cum multo magis alienum sit ab hominis terreni animalis vita
maris interiora, quam terrae viscera scrutari" [8].

{62} "Bias Prienensis capta patria nihil de rebus preciosis exportavit
ex urbe, ut vir qui habitus est sapiens, ab hostibus sibi periculum non
metuerit, quanquam hoc de eo dici vere non possit, quod se coniecerit
in fugam, non magna mihi res videtur esse, iacturam horum etiam bonorum
facere, perdita domo, praedius, patria ipsa, qua nihil charius. Quin
ego iudicarem Biantem istius generis bona contempsisse, ac pro nihilo

putasse, si anteaquam patria capta esset, ea largitus esset cognatis &
amicis, aut distribuisset in egentissimos homines: nam idipsum sine
cotroversia fecisset sua sponte, hoc, quod tantopere miratur Graecia,
vi hostiu coactus & fractus metu fecisse videri potest" [17].

{63} "si metallica ob hanc causam pudenda & inhonesta ingenuo homini
iudicatur" [17].

{64} "qui metalla accusant & ea usu abdicant, non vident se Deum ipsum
accusare, & scelerum damnare, ut quem res quasdam frustra ac sine causa
condidisse autument, & malorum autorem esse putent, quae sane sententia
pius hominibus & peritis viris digna non est" [8].

{65} "Quis igitur non intelligit eam esse maxime utilem, imo potius
necessariam humano generi. ne plura: Homo metallica carere non
potuit, nec ipsum ea carere voluit divina benignitas" [15].

{66} "quomodo terrena cute detracta perfodiunt saxa modo unius generis
& coloris: modo unius generis, sed diversi coloris: modo diversoru
generu, sed unius coloris: nunc vero diversoru generu & coloru. Tam
aut singulorum quam universorum saxorum altitudo incerta est. Nam
universa in quibusdam locis alta sunt viginti passus, in alius amplius
quinquaginta; singula vero alibi semipe dem, alibi pedem unu vel duos
aut plures, alibi passum unu, duos, tres, pluresue. . . . Etenim cum
terreno corio nudati fuerint, primo saxum occurrit, quod est rubru, sed
obscurum, & altum ad passus viginti, vel triginta, vel etiam quinque &
triginta. Deinde alterum item rubrum, sed coloris diluti: id ad duos
passus altum esse solet: sub hoc subiecta est argilla cinerea, alta
fere passum: quae etiamsi metallica non sit, vena est" [86].

{67} "Sed cuniculus est fossa subterranea in longum acta, duplo fere
altior quam latior, ut operarius & caeteri per eum permeare & transire
possint, oneraque efferre. Altus vero solet esse passum unum & quartam

eius partem. Latus igitur circiter pedes tres & dodrantem: cum ferme duo fossores conflueverunt agere: quorum alter altiorem partem effodit, humiliorem: atque ille praecedit, hic subsequitur: uterque sedet in asserculis ex fundamento arctius pertinentibus ad tectum: aut si vena mollis fuerit, interdum in palis, superius latis, inferius cuneatis, & in ipsam venam infixis" [71].

{68} "Itquae primo dicturus sum de fossi onibus venae profundae, de puteis, de cuniculis, de fossis latentibus: deinde de signis bonitatis quae dant canales, quae, materiae fossiles, quae, saxa: deinde quo modo & quibus ferramentis venae & saxa cavantur vel excindutur qua ratione venarum duritiam vis ignium frangit, quibus machinis aqua ex puteris hauritur, quibus aura altissimis puteis & longissimis cuniculus inspiratur, nam alterius affluentia, alterius defectione impediuntur fossiones; deinde de duobus puteorum generibus, & de corum atque cuniculi structura: tum ad extremum quo modo vena dilatata fodienda sit, quo cumulata, quo fibrae" [70-71].

{69} "Cum puteus fuerit rectus vel obliquus qui in eadem defodiatur vena, in qua agitur cuniculus, oritur, ut dixi triangulus cui angulus est rectus. Is autem si duo latera habuerit aequalia, quae ut mersores numerant, secundum & tertium sunt, mensura secunda & tertia erunt aequales: itque etiam intervallum quod est inter os cuniculi & solu putei, atque quod est inter os putei & solum cuniculi, erunt aequalia" [91].

{70} "Parvus aut di metiedus est, atque ex eo existimandum de maiori" [88].

{71} "Licebit autem cuique mensuras ex quibus constat parvus triangulus constituere minores vel maiores, si iugum vel trabs hoc postulaverit,

quam a me costitutae sunt" [91].

{72} "geometriae non ignarus, de reliquaru fodinaru altitudine, in qua canalis venae metalli divitis per saxu illud vagetur, ratiocinari potest" [78].

{73} "Primum duo tigna, quorum utrunque; teres sit, in solo cuniculi paululum effosso, infixa statuuntur erecta: ea sunt mediocriter crassa & tam alta ut verticem cuniculi fere tangant capitibus, in quodrati figuram excisis: deinde superius ipsis imponitur tigillum teres, in cuius formas includuntur capita tignorum: inferius contra alterius tigilli capita, pari modo in quadrati figuram excisa includuntur in formas tignorum erectorum: ad quodque aut spacium passus unius & dimidius similis sit substructio. Unamquamque vero metallici appellant ostiolum, quod patens quidam sit aditus: & certe cum necessitas hoc postulat, fores ad cuiusque ostioli tigna appenduntur, ut claudi possit: tum arbores dissectae, vel extimi earum asseres, & quidem eius longitudinis ut ex uno ostilio pertineant ad alterum, imponuntur superioribus tigillis, & iniusciuntur lateribus: ne pars ex reliquo montis corpore decidens sua mole impedi at transitum, aut ingredientes vel egredientes opprimat: ut praeterea tigna maneant immota, inter ipsa & latera cuniculi adiguntur paxilli lignei. Postremo si saxoru terrarumue glebae euchuntur cisius, asseres inter se coniuncti tigillis inferioribus imponuntur: si capsis patentibus, duo tigna dodrantem crassa & lata: quae, qua parte coniunguntur, cavari solent, ut in eo cavo, quasi in quadam certa via, ferrei capsarum clavi promoveri possint: quibus sane clavis cavetur ne capsae a trita via, hoc est a cavo ad dextram vel sinistr a aberrent: quinetiam sub iusdem tigillis inferioribus collocantur canales, per quos aqua effluit" [85].

{74} "id constat ex semicirculo cera oppleto & sex lineis semi-

circularibus" [95].

{75} "vel instrumetum, quod indicem habet, ei peculiare" [99].

{76} "atque ex ea dimesione cognescit quo loco fossae latetis vel
cuniculi sursum versus fodiendu sit, et quot venae fodiedae passus
restent, ut puteus perfodi possit" [103]

{77} "Simili modo aliter saxum tecti molle & fragile, aliter durum,
aliter durius, aut durissimum. Vena aut putrem eam voco quae constat
ex terris, atque etia succis concretis mollibus: duram, quae ex metal-
lica materia & lapidibus mediocriter duris quales pleruque· sunt qui
facile igni liquescut primi & secundi generis, plumbarius, & similes:
duriore, quae ex iam dictis, sed coiunctis cum silicu generibus, vel
lapidibus, qui facile igni liquescunt, tertius generis: vel pyrite,
vel cadmia, vel marmoribus praeduris: durissima, quae ex his duris
lapidibus & mistis, si tota aliqua venae ipsius parte fusae fuerint"
[78].

{78} "Si praeterea cavum fuerit humile, una tantummodo lignorum strues
in ipsum imponitur, in sius altum duae & quidem altera super alteram"
[80].

{79} "aut si sustinuerint, anhelitum libere trahere nequeunt, & capitis
delores habeant" [81].

{80} "in hoc exponam praecepta venae similiter cuiusque fodiendae, &
artem mensorum" [70].

{81} "nunc dica de signis quae dant canales, materiae fossiles, saxa"
[75].

{82} "Vulgus aut metallicorum fibras probat, quae ex septentrionibus
procedentes, se cum vena principali iungunt: contra improbant eas, qua
prodeut ex meridie, dicitque has multum nocere venae principali, illas

prodesse: sed equidem neutras praetermitti a metallicis & negligi

debere censeo: atque ut libro tertio ostendi experimentum non

cosentire his, qui sic de venis censent, ita nunc etiam supponerem

exempla uniuscuiusque fibrae a vulgo reiectae, quibus eius bonitatem

probarem, nisi scirem ea posteritati parum aut nihil prodesse posse"

[75].

{83} "testudinis, vel subterraneae alicuius cellae, multos annos

undique coclusae instar" [81].

{84} "Fossas aut latentes aeque ac cuniculos substruunt metallici:

attamen tigillis inferioribus non indigent, nec canalibus" [86].

{85} "Eiusmodi vero fossae latetes & occultae Graeco nomine etia

appellantur: quod more cuniculi longius procedetes intus in terra

occultetur: veruntamen hoc genus fossaru differt a cuniculo, quod

illud ipsum per se sit caecum, hic os habeat subdiale" [74].

{86} "de qua, quia quisque in arithmeticis paulu exercitatus id facere

potest, posthac non monebo" [92].

{87} "cum interdum vena sit admodum dura, igni frangitur: unde sit ut

fulturis, quae molles siunt, dissolutis, vel substructionib cobustis,

mons magna mole in se cadat, vastoque haitu absorbeantur puteoru

structurae: quocirca utile erit aliquot puteos, eiusmodi ruinis no

subiectos, circu cumulata venam fodere" [87].

{88} "magnos errores gignet" [88].

APPENDIX B: SAMPLE TECHNICAL WRITING TEXTBOOKS

Included here are some of the generic technical and business
writing textbooks--textbooks that do not apply technical writing to a
particular field (such as sociology, chemistry, engineering, etc.)--
that include the elements of the standard technical writing introduc-
tion. Works listed here are part of the Oklahoma State University
library's collection of technical writing textbooks.

Cypert, Samuel A. Writing Effective Business Letters, Memos,
      Proposals, and Reports. Chicago: Contemporary Books, Inc., 1983.

Fear, David E. Technical Writing. New York: Random, 1973.

Freeman, Joanna M. Basic Technical and Business Writing. Ames, IA:
      Iowa State UP, 1979.

Holcombe, Marya W., and Judith K. Stein. Writing for Decision Makers:
      Memos and Reports with a Competitive Edge. Belmont, CA: Lifetime
      Learning Publications, 1981.

Hoover, Hardy. Essentials for the Technical Writer. New York: John
      Wiley & Sons, Inc., 1970.

Houp, Kenneth W., and Thomas E. Pearsall. Reporting Technical Informa-
      tion. 5th ed. New York: Macmillan, 1984.

Lewis, Phillip V., and William H. Baker. Business Report Writing.
      Columbus, OH: Grid, Inc., 1978.

Mathes, J. C., and Dwight W. Stevenson. Designing Technical Reports:
      Writing for Audiences in Organizations. Indianapolis: The Bobbs-
      Merrill Company, Inc., 1976.

Mills, Gordon H., and John A. Walter. Technical Writing. 4th ed. New
York: Holt, 1978.

Pauley, Steven E. Technical Writing Today. Boston: Houghton, 1973.

Pickett, Nell Ann, and Ann A. Laster. Technical English: Writing,
Reading, and Speaking. 4th ed. New York: Harper, 1984.

Schmidt, Steven. Creating the Technical Report. Englewood Cliffs, NJ:
Prentice, 1983.

Ulman, Joseph N., Jr., and Jay R. Gould. Technical Reporting. 3rd ed.
New York: Holt, 1972.

Warren, Thomas L. Technical Writing: Purpose, Process, and Form.
Belmont, CA: Wadsworth Publishing Company, 1985.

$\curvearrowright_\angle$

VITA

Bobbie Jo Allen

Candidate for the Degree of

Doctor of Philosophy

Thesis: AGRICOLA'S DE RE METALLICA: A 16TH-CENTURY LINK IN THE
          EVOLUTION OF TECHNICAL WRITING

Major Field: English

Biographical:

   Personal Data: Born in Goldsboro, North Carolina, December 4, 1957,
        the daughter of Robert D. and Lorraine B. Allen.

   Education: Graduated from Arendell Parrott Academy, Kinston, North
        Carolina, in June 1976; received Bachelor of Arts degree in
        English from Meredith College in May, 1980; received Master of
        Arts degree from East Carolina University in August, 1983;
        completed requirements for the Doctor of Philosophy degree at
        Oklahoma State University in May, 1986.

   Professional Experience: Teaching assistant, Department of English,
        East Carolina University, August, 1980 to May, 1982; Part-time
        instructor, Department of English, Pitt Community College, June,
        1981 to June, 1982; Teaching assistant, Department of English,
        Oklahoma State University, June 1983 to present. Member,
        Society for Technical Communication. National Council of
        Teachers of English. Phi Kappa Phi.