1988

What Socrates Began: An Examination of Intellect Vol. 1

University of Southern Maine

What Socrates Began: An Examination of the Intellect

Vol. 1

Walter E. Russell
Endowed Chair in Philosophy and
Education Symposium
1987

edited by
Libby Cohen

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Editor

Published by the University of Southern Maine
Portland, Maine

ISBN 0-939561-01-8

This monograph is printed in accordance with requirements of the Walter E. Russell Chair in Philosophy and Education. The holder of the chair presents one or more public lectures on issues in education and/or philosophy.

Dr. Russell was the second principal of Western Maine Normal School at Gorham (1905-1940) and a teacher at that institution for many years. The University of Southern Maine is a successor institution.

Winifred S. Russell, Dr. Russell's widow, endowed the chair in her will, stating that the position is to be "devoted to the teaching of subjects which were not only Dr. Russell's professional specialties, but the passion of his life, and will perpetuate his name on a campus where he served with unusual distinction and fidelity."

A distinguished record of service at USM and evidence of significant achievement "in teaching and scholarly activity involving education and/or philosophy, service to the university and public service" are the qualifications.

The terms of Mrs. Russell's will require that each two years a member of the USM faculty be appointed to hold the chair for a period of two years. There is no limitation on the number of terms an individual may hold the chair; on the other hand, a different individual might be appointed at each two-year interval.

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PREFACE

On March 26, 1987, a symposium designed to explore various aspects of thinking and its application to the curriculum was held at the University of Southern Maine. The symposium, organized under the broad title "What Socrates Began—An Examination of the Intellect," was conducted under the sponsorship of Walter E. Russell Endowed Chair in Philosophy and Education. Faculty from many disciplines participated in a number of lively and enthusiastic sessions.

Many of the papers that were presented at the symposium are included in this monograph. Critical thinking is a new kid on the block and there is considerable disagreement over how to define it, whether it can be developed, and its place in the curriculum. The chapters in this monograph present a variety of perspectives on the topic of thinking.

The lesson of Aladdin is not only that we must be cautious with genies, but also that we should not exchange new lamps for old until we know the value of each. The symposium, with the encouragement of the Russell Family, was an opportunity for the University community to pause, as we seldom do in our hectic academic lives, to examine the old lamps and the new.

In reviewing some of the Russell family memorabilia, I was struck by the enormous contribution that Walter E. Russell and his family have made to education—a combined total of 400 years commitment to education. As one writer said of the Russell family, "probably they have not a parallel in New England." The support and encouragement of the Russell family is gratefully acknowledged.

I am also grateful to a number of other individuals. Alyce O'Brien, Mary Schools and Frances Langford were invaluable in organizing the symposium. Rebecca Neidetcher, Sue Donovan, and Karyn Swiger helped with many of the details of the planning for the symposium. I appreciate the colleagueship and friendship of Barbara McGough, Toni Rees, Jim Curry, Jo Anna Spruill, and Kathy Turlo. Julie Cameron and her staff have my deep gratitude for their work on this monograph. My colleagues at the University of Southern Maine who presented at the symposium have my deep thanks. Finally, Les and Seth were always there to provide support, encouragement, and understanding.

Libby G. Cohen
Walter E. Russell Professor of
Philosophy and Education

DEDICATION

To Jim Curry, Barbara McGough, Toni Rees, Jo Anna Spruill, and Kathy Turlo

Part I:
Theoretical Aspects

THINKING ABOUT THINKING: MEMES AND THEMES

Libby G. Cohen

> I have heard this ever since I can remember, and ever since I have taught: the teacher must teach the pupil to think (Frost, 1966, p.41).

How many times have we heard the admonition, "Think!"? Although this seems like good advice, when queried would the admonisher be able to also give advice on how to think? It certainly is easier to give the advice than to tell people how to do it. But perhaps this is putting Socrates and "Descartes before des horse" (Mann, 1986, p. 149). Today, I want to discuss several perspectives of critical thinking, to suggest components of thinking, and to reflect upon some of the current thinking about thinking.

What does it mean to think? The word "think" is used in a variety of ways.

> Consider the following examples: 'What do you think about X?' 'I think this is the one I saw, but am not sure.' 'When I think about my childhood, I get nostalgic.' 'I did not think about that.' 'One should think carefully before deciding what to do (Nickerson, R.S., Perkings, D.N., & Smith, E.E., 1985, p. 3).

In these examples, think means consider, believe, remember, ponder, and reflect.

What do we mean when we talk about critical thinking? Which of the following list of student activities focuses on the development of critical thinking (O'Rielly, 1985):

1. Students produce a slide tape on women's rights issues (problem solving).
2. Students discuss ways that the United States could have dealt with the Depression (divergent thinking).
3. Students memorize various United Nations agencies (memorization).
4. Students assess an argument on McCarthyism (evaluation).

The study of thinking is not unique to the 1980s (Bransford, Sherwood, Vye & Rieser, 1986). At least since the rise of the Greek city-state, the use of the mind has been valued. Plato, arguing for the need for mental discipline, wrote that "arithmetic stirs up him who is by nature sleepy and dull, and makes him quick to learn, retentive and shrewd. He makes progress quite beyond his powers" (Mann (1979) cited by Bransford, Sherwood, Vye & Rieser, 1986, p. 1078). "Socrates' 'Know thyself,' Aristotle's 'All men by Nature desire to know, and Descartes' 'I think: therefore I am' provide epigraphs that frame an entire civilization" (Gardner, 1983, pp. 5-6).

Numerous writers (Sternberg, 1986a; Dewey, 1933; McPeck, 1981) have defined and discussed critical thinking. The problem is not that we lack a definition, but that there are so many definitions and terms and few writers can agree on any one. To illustrate, I want to develop an analogy using Douglas Hofstadter's (1985) concept of viral sentences and memes (meme rhymes with themes and schemes).

Viral sentences are similiar to viruses. These are "small objects, getting the hosts by hook or by crook to carry out a complex sequence of replicating operations" (Hofstadter, 1985,

p. 49). These sentences are selfish—they grab the space of ideas, make copies of themselves and over take the space of ideas. Hofstadter (1985) has theorized that there is a competition from other sentences and that all sentences are engaged in an evolutionary struggle for survival. If a sentence succeeds it has a niche in space—it is an ideosphere.

In 1976, the biologist Richard Dawkins published *The Selfish Gene.* Dawkins called the unit of replication and selection in the ideosphere a "meme." Examples of memes are ideas, tunes, and catch-phrases. Memes propogate themselves by leaping from brain to brain via imitation. Hofstadter wrote, "When I muse about memes, I often find myself picturing an ephemeral flickering pattern of sparks leaping from brain to brain, screaming Me, me!!" (Hofstadter, 1985, p. 52). Examples of little memes, which are humorous in themselves, are: "If you copy me, I'll grant you three wishes" and "Say me or I'll put a curse on you!" (Hofstadter, 1985, p. 52-53). Dawkins wrote that "Socrates may or may not have a gene or two alive today but the meme complexes of Socrates, Leonardo, Copernicus and Marconi are still going strong" (Dawkins, 1981, p. 144).

The meme complexes of Dewey, Sternberg, Gardner, and other theorists in the area of critical thinking are rampant. Their memes are competing for space in our ideospheres. Some of these theorists have examined philosophies of logic and reasoning; others have examined the epistemology of specific subject domains; several have synthesized various perspectives and derived their constructs from the syntheses; and finally, a fourth group have proposed their own definitions and lists of associated skills (Quellmalz, 1984).

A frequently cited definition of critical thinking is found in John Dewey's book *How we Think.* Dewey wrote that reflective thought is the "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (p. 9). Thinking is triggered by some perplexity or doubt. The next step is to form a tentative plan that will account for the doubt. According to Dewey, the sources of a solution to a problem are found in past experience and acquired knowledge. An act of searching, hunting, and inquiring is necessary in order to find the solution to the perplexity. B. Othanel Smith (1953) associated critical thinking with language and logic. He believed that critical thinking is manifested in observable behavior and is "a form of problem solving in which the purpose is to decide whether or not what is said is dependable" (p. 130).

Arguing that critical thinking consists of more than raising questions, McPeck (1981) wrote that it involves the "appropriate use of reflective scepticism within the problem area under consideration" (p. 7). Knowing when and how to use reflective scepticism depends on the subject area. Thinking skills are not transferable, according to McPeck, but are dependent on the specific subject area in which the skills are to be used and on the disposition to use these skills. McPeck wrote that "the criteria for the judicious use of scepticism are supplied by the norms and standards of the field under consideration" (McPeck, 1981, pp. 7-8).

The teaching of logic to improve critical thinking has been called the philosopher's fallacy (Johnson, 1987). Equating critical thinking with formal logic may be rigid and narrow because, according to McPeck (1981), critical thinking rests on the field dependent epistemology, e.g., knowledge of the belief systems of a discipline. He wrote, that when a person suspends judgment for the purpose of using epistemic understanding of an issue, then that person is a critical thinker. (McPeck, 1981).

Both Nickerson (1986) and Johnson-Laird (1985) recognized that knowledge of the rules of

logic alone are insufficient for thinking but Nickerson (1986) has hypothesized that one requisite of critical thinking is "procedural knowledge" or the ability to evaluate informal arguments. Although considerable work has been done on studying the use of formal logic in evaluating arguments, almost no studies have been conducted that examine the ability to evaluate informal arguments.

A contrasting position has been presented by Matthew Lipman (1984), the developer of the "Philosophy for Children" program. Defining philosophy as "thinking that devotes itself to the improvement of thinking" (Lipmann, 1984, p. 51), Lipmann has advocated the teaching of philosophy as the best method of developing reasoning skills in children in order to analyze the "logical, epistemological, ethical, or aesthetic aspects of the problems under discussion" (p. 56.). Thus, Lipman believes, unlike McPeck and some others, that thinking skills are generalizable.

Robert Ennis (1985), like Lipman, considers thinking skills to be generalizable and has defined critical thinking as "reasonable, reflective thinking that is focused on deciding what to believe or do" (Ennis, 1985, p. 54). Robert Sternberg (1986a) has written that "critical thinking comprises the mental processes, strategies, and representations people use to solve problems, make decisions and learn new concepts" (p. 46.).

These preceding conceptualizations of critical thinking have several common threads including a disposition to be reflective, the use of analysis, judgment, pragmatic and formal reasoning, and the use of evaluation. Many other definitions and conceptualizations of critical thinking have been offered. Most of these definitions, aside from Sternberg's have either deemphasized or neglected to include the use of strategies that are used to plan and monitor thinking processes. "In order to reach a successful verdict in a trial or to complete an analysis or knowledge as design, one must combine a complex set of processes in a way that may not lead to anything concrete" (Sternberg, 1987, p. 253). These strategies have been widely written about as metacognitive strategies. Nickerson, Perkins, and Smith (1985) have defined metacognitive knowledge as:

> knowledge about knowledge and knowing, including knowledge about the capabilities and limitations of human thought processes, about what human beings in general might be expected to know, and about the characteristics of specific people—and especially oneself—as knowing and thinking individuals. Metacognitive skills may be thought of as cognitive skills that are necessary, or helpful, to the acquisition, use, and control of knowledge and other cognitive skills. They include the ability to plan and regulate the effective use of one's own cognitive resources" (Nickerson, Perkins & Smith, 1985, p. 101).

A definition of critical thinking must include an emphasis on mental processes and metacognitive strategies that are used to identify and solve problems, evaluate decisions, make judgments and use reasoning.

When examining any definition of critical thinking, we should also be interested in the assumptions of that definition. Does the definition assume that critical thinking and critical thinking skills are the same? Is critical thinking discipline specific? Are some skills transferable to other disciplines? What are the assumptions about the age at which critical thinking develops? What assumptions are made about the biological bases of thinking? Most of the current conceptualizations of critical thinking are hypothetical and there is little agreement on any one or on their underlying assumptions. Empirical investigation of the conceptualiza-

tions of critical thinking, their assumptions and implications is urgently needed (Quellmalz, p. 192).

Why is Critical Thinking Important?

Why is critical thinking important? A recent front page article in *Education Week* (1986) stressed that instruction in all areas of the curriculum was deficient in higher-order skills. McTighe and Schollenberger (1985) believe that the characteristics of present and future societies demand that students' thinking skills be developed. Malcolm Knowles (Myers, 1986) wrote that the increasingly complex demands of our society require that teachers emphasize the skills and attitudes necessary for self-directed inquiry. Siegel (1980) stressed that teaching students how to think critically should be an educational ideal because students have a right to ask challenging questions, because they should be assisted in becoming competent adults and be empowered with the ability to think critically, and because students should be helped to understand and appreciate the role of reason in rational endeavors. Paul (1984) has argued that critical thinking is basic to education in a free society. Finally, McPeck has written, "Among people who bother to think about education at all, reflective parents, theorists, radical reformers and traditionalists alike, there is a prevailing opinion that the ability to think critically is a desirable human trait, and that for this reason it should be taught in our schools whenever possible" (McPeck, 1981, p. 1).

There has been an unusual consensus on the importance of critical thinking. Several educational organizations, including the National Council of Teachers of Mathematics, The National Council of Teachers of English, the National Council for the Social Studies, and the Association for Supervision and Curriculum Development have called for the nurturing of critical thinking in students. These groups consider the teaching of critical thinking skills to be of the highest importance and that "educators need to take renewed action to bring about qualitative improvements in student thinking" (McTighe and Schollenberger, 1985). The state college and university system of California requires that every student enroll in a course in critical thinking before graduation (Myers, 1986). Alverno College in Wisconsin has received recognition for its innovative curriculum which emphasizes critical thinking in various disciplines (Myers, 1986).

Critical Thinking Skills

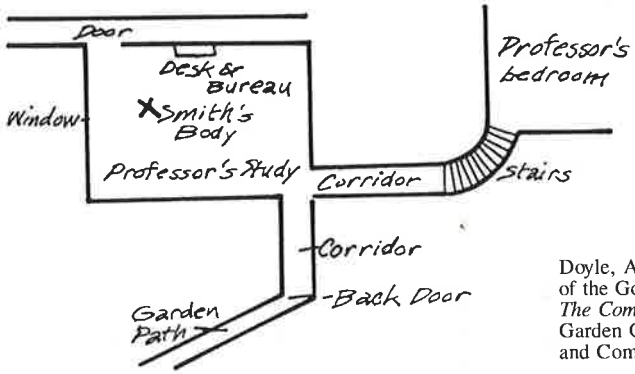
What is the difference between critical thinking and critical thinking skills? Dewey (1933) proposed a five-step process that critical thinkers use which includes: 1) identification of a problem; 2) analyzing the problem; 3) suggesting possible solutions; 4) testing consequences; and 5) judging the selected solution (Quellmalz, 1984). While emphasizing the judgmental dimensions of critical thinking, B.O. Smith "limited their application to problems of logical reasoning presented to the student, i.e., 'what a statement means and whether to accept or reject it'" (Smith, 1953). Ennis elaborated Smith's view by delineating twelve skills involved in the 'correct assessment of statements' (Ennis, 1962). Quellmalz, (1984) has suggested that "Throughout these conceptualizations of critical thinking run some common skills. These include: 1) an attitudinal component, suggesting an awareness, a disposition to be reflective; 2) an analytical component involving the identification of relevant information; 3) a component for weighing evidence; 4) a component involving knowledge of pragmatic and formal methods of reasoning; and 5) the act of evaluation" (Quellmalz, 1984, p. 192).
Critical thinking skills can be grouped into two different categories or components, metacognitive processes and cognitive processes. The category of cognitive processes includes the skills of analysis, comparison, inference, interpretation, and evaluation.

Metacognitive processes include the planning, monitoring, reviewing, and revising of problems or tasks (Quellmalz, 1987).

Adopting a skills approach to critical thinking is similiar to the basic skills approach to reading. But reading cannot be reduced to a few mechanical skills (Johnson, 1987). Reading is a complex process and researchers in critical thinking may need to revise their conceptualizations of the process used in critical thinking. A skills approach may be too simplistic.

Sherlock Holmes is recognized as having superb thinking skills.[1] In order to test your own reasoning skills consider the following excerpts from Arthur Conan Doyle's *The Adventure of the Golden Pince Nez* (Doyle, 1930) in which Inspector Stanley Hopkins related the stabbing of Willoughby Smith. Sherlock Holmes' solution to the mystery will be related at the end of these remarks.

> A maid has just entered the professor's study and discovered the body of Willoughby Smith and "at first the maid thought that young Smith was already dead, but on pouring some water from the carafe over his forehead he opened his eyes for an instant. 'The professor,' he murmured, 'it was she'" (Doyle, 1930, p. 610).
>
> "The housekeeper hurried to the professor's room. He was sitting up in bed, horribly agitated, for he had heard enough to convince him that something terrible had occurred" (Doyle, 1930, p. 610). The housekeeper related that "the professor was still in his night-clothes... He can give no explanation of the young man's last words, 'The professor—it was she,' but imagines that they were the outcome of a delirium" (Doyle, 1930, p. 610).
>
> The Inspector then showed Sherlock Holmes an important piece of evidence—a golden pince-nez. The Inspector said, "Willoughby Smith had excellent sight"..."There can be no question that this was snatched from the face or the person of the assassin" (Doyle, 1930, p. 612). Finally, the Inspector produced a rough map which provided the layout of the murder scene. This map is reproduced below.



Doyle, A.C. (1930). "The Adventure of the Golden Pince-nez." In the *The Complete Sherlock Holmes.* Garden City, New York: Doubleday and Company, Inc., p. 610.

[1] I am indebted to Johnson-Laird (1985) for the idea for this example.

Requisites of Thinking

As you continue to ponder the solution to the *Mystery of the Pince-Nez,* you will be using cognitive processes and metacognitive processes. But are there other requirements of critical thinking? What were the requisite components of thinking that Sherlock Holmes needed in order to solve this problem? Sternberg (1987), writing that "there is more to being a good thinker than just having the right thought processes" (p. 253), has suggested that there are elements that are necessary for good thinking. Nickerson (1986), rather than viewing these elements as prerequisites believes that "our ability to reason is constrained somewhat by natural limitations" (p. 358). Although we have yet to conduct a "factor analysis (that) would provide a periodic table to the mind" (Sternberg, 1987), the literature suggests that there are several other requirements of critical thinking.

Knowledge about a particular subject that has been acquired by the thinker is a requisite of critical thinking. Thinking does not occur in the absence of knowledge; the thinker must have something to think about. Nickerson (1986) has written, "the more one knows about a subject, the more effectively, other things being equal, will one be able to reason about that subject. When two equally intelligent people are engaged in a dispute and one of them is much more knowledgeable about the topic of the dispute than the other, there can be little question that the less knowledgeable person is at a significant disadvantage" (p. 359).

Another requisite of thinking is the ability to construct a model of the topic that is being thought about. In one study, Perkins (Perkins, 1982 cited by Nickerson, 1986) found that the difficulties people have with informal reasoning were "problems of inadequate model building, that is, failures to elaborate a model of the situation under consideration" (Nickerson, 1986, p. 359). Sternberg (1987) has said that mental models also include dialogical thinking—the ability to see problems from different points of view. Johnson-Laird (1985) believes that the ability to construct metal models of situations "is a process that occurs in most of the ordinary comprehension of discourse" (p. 316).

Even if Sherlock Holmes had the right thinking processes, he would not be able to solve the mystery if he were not motivated to do so. Motivation is an essential requisite of critical thinking. Alfred North Whitehead wrote, "There can be no mental development without interest. Interest is the *sine qua non* for attention and apprehension. You may endeavor to excite interest by means of birch rods, or you may coax it by the incitement of pleasurable activity. But without interest there will be no progress (Whitehead cited by Myers, 1986, p. 40). Sternberg (1986) described the results of two studies that were designed to train students in learning how to learn. Although there were several differences between the studies, he concluded that "it was clear from the start that one difference overshadowed all the others—motivation on the part of the students and on the part of the teachers" (p. 380).

One of the most important objectives in teaching critical thinking processes is the nurturing of positive attitudes (Nickerson, 1986). The encouragement of the development of critical thinking processes and the monitoring of their use should be a major instructional objective (Sternberg, 1987). Instructional programs like the Philosophy for Children program (Lipman, 1980) and the Instrumental Enrichment Program (Feuerstein, 1980) were constructed to promote the development of positive attitudes toward thinking. There has been little research on the preferred ways of promoting and maintaining motivation. Nickerson (1986) wrote: "How to instill such attitudes in students? I do not believe we know the answer to that question" (p. 369).

Dilemmas for the Future

Jeremy Bernstein (1987) described an imagined mental affliction that he thought he had called "grasshopper mind." As a young child he was an eager reader of comic books and in the back of one of the comic books was a classified ad which showed an unhappy man with a cartoon balloon attached to his head. Inside the balloon was a potpourri of thoughts which Bernstein described:

> The man was suffering from this terrible grasshopper mind. I was sure I also had it, since I seemed to be so unfocussed. It was radios one day, skis the next, and Harriet Dorsey, a next-door neighbor with whom I had rigged a bedroom-to-bedroom telegraph system, the third. You could send away for a treatment for grasshopper mind, but for me it was prohibitively expensive. I simply resigned myself to suffering from it—probably forever (Bernstein, 1987, p. 42).

Thinking about thinking can be a little like having "grasshopper mind." Although we know a great deal about critical thinking, much work remains to be done. But, unlike Bernstein, I am not resigned to this malady forever. Gertrude Stein, on her death bed, is said to have asked, "What is the answer?" Hearing no answer she said, "In that case, what is the question?" (Toklas (1963) cited by Sternberg, 1985, p. 1111). As I read and think about critical thinking a number of questions were raised for me.

How do the hypothesized skills of critical thinking compare with what neuroscientists, computer scientists, and others have discovered about the functioning of the brain? If there are four, five, or ten critical thinking skills can we assume that there are selective neurons for them? During the past 20 years, the physical functioning of the brain has been extensively investigated. There are more nerve cells in one human brain than the entire population on the earth and these nerve cells can communicate with each other in a thousandth of a second (Lance 1987 p. 10). We are challenged to describe how current theories of critical thinking relate to what we know about the structures of mental organization. As Lance said, "And that's what brains are for" (Lance, 1987, p. 10).

Israel Scheffler (1985), in his book, *Of Human Potential,* identified three myths: the myth of fixed potentials; the myth of harmonious potentials; and, the myth of uniformly valuable potentials. If we agree with Scheffler, then critical thinking skills and their requisite components are not equally useful and valuable, and they are not unalterable. Scheffler wrote:

> If potentials are not fixed but unalterable, we need to reflect how our own efforts might strengthen or weaken, alter or sustain them. If they conflict, we face the need to discriminate among them. If mixed in value, we need to choose which to promote, which to reduce. (Scheffler, 1985, p. 92).

Any curriculum materials that are used to promote critical thinking "must make plain that specific value choices are involved and not simply a maximal development of students' talents, and independently understood" (Scheffler, 1985, p. 95). The assessment and teaching of critical thinking is not free of assumptions and values.

One of the challenges in nurturing critical thinking in students will be to obtain a happy marriage between cognition and instruction. How can we achieve this marriage—without it ending in divorce (Sternberg 1986b)? Before implementing a program designed to promote critical thinking, theories about cognition, instruction, motivation, learning, mental processing, and student ability will have to be examined. While I have argued that it is better

to be prudent rather "than to wait until a later postmortem that seeks to discover just what went wrong" (Sternberg, 1986, p. 382), I believe that we have to get on with it. Assumptions about critical thinking can be made, tentative definitions formed, and programs implemented. But empirical testing of our assumptions and hypotheses about the nature of critical thinking should not be neglected.

I hope that this book will be an opportunity to review what we know, what we do not know, and what we would like to know about critical thinking. In the meme's evolutionary struggle for survival, there is space for the evolution and maturation of ideas about critical thinking. We need ideas about critical thinking that can grab us and say, "Create me!" "Try me!"

Walter E. Russell has been described as a "man of vision, steadfast in his purposes and ideals, a guide, a philosopher and a friend." Dr. Russell and the Russell family have nurtured a tradition of commitment to education and thinking. As you read the chapters in this book, you will be following in this tradition. I want to end with an excerpt by Jorges Luis Borges:

> To discover the unknown is not a prerogative of Sinbad, of Eric the Red, or of Copernicus. Each and every [hu]man is a discoverer. He begins by discovering bitterness, saltiness, concavity, smoothness, harshness, the seven colors of the rainbow and the diversity-some letters of the alphabet; he goes on to discover maps, animals and stars. He ends with doubt, or with faith, and the almost total certainty of his own ignorance (Borges, 1984, pp. 7-8).

Solution to the Sherlock Holmes Mystery

The murderer could not have walked along the garden path without making a false step because the dying man had the pince-nez and Sherlock Holmes had discounted the possiblity that the murderer had a second pair of glasses. It seemed that the murderer had entered the professor's room since there was no other exit. Thus, the professor knew who the murderer was and that she was hiding in the professor's bedroom.

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CRITICAL THINKING IN THE COLLEGE CURRICULUM: SOMEWHERE OR NOWHERE?

Craig Dietrich

This paper discusses some of the difficulties of developing college curricula which foster the teaching of critical thinking. Such an effort must negotiate the uneasy relationship between, on the one hand, the research of philosophers, psychologists, and education specialists and, on the other, the practical matter of what and how to teach, and in which courses. These complexities are compounded by the fact that it is very difficult to get agreement among academics on a definition of critical thinking. In all this confusion, we must endeavor to work out a reasonably acceptable notion of what critical thinking is, and then to find ways to nurture that in our curriculum.

At USM we have recently been working on this problem as part of a more general effort to review the Core curriculum. Of the study groups we assembled, one was a task force to examine our "Skills of Analysis/Philosophy" requirement. (At the outset, this term, "skills of analysis," requires some comment. In our curriculum it has not consistently carried the restricted meaning that the word "analysis" might imply, but rather seems to be taken to mean good or effective thinking. In this paper I will use "skills of analysis" interchangeably with "critical thinking.")

In our core, "Skills of Analysis/Philosophy" has been grouped with English composition, and "quantitative decision making" as a "skill" or "competency." Thus, we assert that students must sharpen their basic "skills" in thinking, just as they must develop their abilities in writing and using numbers. These three "competencies," as we call them, should presumably be developed before the student takes too many other courses. "First learn how to write, compute, and think," we seem to be saying.

Now for this prescription to be legitimate there must exist some general thinking skills (or "Skills of Analysis") which can be imparted in a course (usually in an introductory philosophy course) and then transferred to other areas. This was the assumption in 1982. At that time the University's Core Council drew up a set of criteria by which "Skills of Analysis/Philosophy" courses would be approved. There were seven:

> A course in Skills of Analysis should: (1) demonstrate the distinction between the dynamic process of analysis and the form of logical argument; (2) compare and contrast analysis to other cognitive processes such as remembering, describing, and reconstructing; (3) establish that analysis is an idiosyncratic and creative process; (4) teach the principles and processes of analysis which include the definition of the problem, the development and maintenance of an integrated approach, the discovery of acceptable premises, and the attainment of tentative conclusions; (5) present the study of deductive and inductive logic as the main support for good analysis; (6) help the student critique an argument; to distinguish between sound and unsound arguments; to identify non-arguments; and to analyze reasons, conclusions, and argument connectives; (7) differentiate between arguments based on value and arguments based on fact.

Now, when the Skills of Analysis Task Force first assembled in the fall of 1986, some of its members expected that we could simply discuss these criteria. Our job would be to amend

these criteria as seemed wise and perhaps even identify ways to assess student abilities in this area. Unfortunately, those expectations turned out to be naive.

The initial reaction to these desiderata on the part of those who had been teaching the courses was, "Where did they come from anyway? Why have we never seen them?" Here was an instructive revelation that a wide gap can exist between written declarations and the actual functioning of the curriculum; official rhetoric can exist in isolation from what professors actually do.

But that was only the beginning of the questions about these criteria. For example, it was asked: what exactly does the statement "should establish that analysis is an idiosyncratic and creative process" (criterion 3) mean? It was not at all obvious. And there was the objection that these criteria mainly describe argumentation (see points 1, 5, 6, 7). Should "skills of analysis," or "critical thinking," be conceived of as argumentation? Some of us felt that this was indeed appropriate. In this view, teaching students about sound and unsound argument, is, if not a sufficient goal of general education, at least a necessary one. Instruction in this skill can be incorporated in an introductory philosophy course, and the students who receive it should be able to read, think, and argue better—which should please everyone. We were accepting the original notion that you can incorporate a component of generic "thinking" (here meaning argumentation) into the curriculum.

Two kinds of objections surfaced. One sort was "technical," e.g., that integrating argumentation into an introductory philosophy course necessarily cuts down on the philosophical content that can be imparted. Moreover some participants considered the formal terminology of argumentation (post hoc ergo propter hoc, slippery slope, etc.) to be jargon and held that argumentation skills can be nurtured more intuitively in the process of examining the positions of important thinkers.

Another, more fundamental, kind of objection was that other sorts of thinking are equally or perhaps even more important than argumentation and deserve the name, "critical thinking." This led us into the swamp of definitions. The following are offered as a sampling of the diverse approaches to this question.

Montclair Teachers College, in its Philosophy for Children program, lists thirty thinking skills. They include: formulating concepts precisely, making appropriate generalizations, formulating cause-effect relationships, making immediate inferences from two premises, knowing elementary rules of standardization, knowing the rules governing ordinal and relational logic, etc. (Lipman 1985).

The editor of a 1986 report on assessing thinking skills presents a list of higher order thinking skills which includes: comparing and contrasting, making inferences, analyzing events, synthesizing information, drawing conclusions, identifying the problem, analyzing the problem, and other terms totalling 41 in all (Kearney, et al. 1986). We note that both this list and the Philosophy for Children list are unstructured; the order of items has no significance.

Then there are taxonomies. One thinks of Benjamin Bloom's "taxonomy of educational objectives" and its hierachy of six items: knowledge, comprehension, application, analysis, synthesis, and evaluation. There is also Barbara Presseisen's brief review of the field in which it is argued that there are four categories of "cognitive processes": namely, essential cognitive processes, higher order cognitive processes, epistemic cognitive processes (that is to say,

those related to particular subject areas), and metacognitive processes (those somehow transcending particular subject areas) (Presseisen, 1986). Both the Bloom and the Presseisen hierarchies move from simpler to more complex thinking.

According to the faculty of Alverno College, critical thinking consists of: analytic thinking and communicating, synthesis, judgment, reflection, collaborative thinking and communicating, articulating ideas, awareness of values in making choices, asking significant questions, problem solving, organizing, openness to contradictory ideas, evaluation of self and others (Mentkowski and Cromwell, 1985).

But before getting too comfortable with the problem posed in this way, we must confront still another complication. A debate is currently raging over how deeply critical thinking is imbedded in specific disciplines or subject matter areas. One school of thought, which is strong and seems to be growing stronger, argues that critical thinking is always thinking about something. To quote the bolder language of John McPeck (1981), "Purporting to teach critical thinking in the abstract, in isolation from specific fields or problems areas, is muddled nonsense..." On this view, the attempt to inculcate transferable generic critical thinking would be a serious mistake. And when we look at some of the literature on "problem solving" and novice vs. expert behavior, it also seems that expertise is quite specific to a certain subject matter: the nuclear arms negotiator is likely to be quite inexpert at nearly everything else from fixing the car, to scanning verse, to programming computers. The obvious casuality of this discipline-specific view of critical thinking would be those parts of a curriculum (such as we have) which aim to teach generic critical thinking.

On the other hand, those who cut their academic teeth on Piaget's "formal operations" concept cannot have fled the battlefield entirely. The Philosophy for Children program cited above describes thinking in generic terms that cut across specific domains. A theoretical discussion that needs to be noted here is Donald Davidson's (1984) article which argues that it is very difficult to sustain the view that there exist completely separate conceptual schemes. Davidson concludes with a dilemma: "...we have found no intelligible basis on which it can be said that schemes are different...[but] neither can we intelligibly say that they are one."

Or to cite one further example of unwillingnes to go all the way with McPeck, we have Chet Meyers (1986) first asserting, "Recent studies have suggested that there is little carry over between the understanding of the skills of logic and the application of good critical skills in other disciplines" and then a few pages later admitting, "...logic and problem solving do provide useful points of departure for more specific approaches to critical thinking. After all, critical thinking in all disciplines does incorporate basic elements of logical reasoning...."

Now if the exclusionary school of thought is correct, then clearly we should revamp our curriculum because you can't teach generic critical thinking and expect it to transfer from one subject area to another. But are they really right? Do we not run the risk of riding the latest wave in educational theory only to have to reverse course later? The problem becomes all the more ticklish when we take into account the heavy costs of major curricular overhaul.

So what do we do? I must confess that at times I felt that our task force resembled nothing so much as a nervous flock of birds in an orchard. As a practical matter, the flock must at some time come to rest on some particular tree, even if it cannot be sure that this is the best tree. But no sooner do one or two birds alight than they all take flight again. Like the birds, we can't remain uncommitted indefinitely, and it may be hoped that we won't simply go back to the old branch where we have been roosting for some time.

If I had my way, we would proceed as follows. We would attempt to agree on some taxonomy of critical thinking. My preference would be for one that is not as general as Alverno's, yet not limited to skills of logic and argumentation. A good candidate might be Presseisen's hierarchy, mentioned previously, of (1) essential cognitive processes, (2) higher order cognitive processes, (3) epistemic cognitive processes, and (4) meta-cognitive processes. Having embraced a theory, we would then attempt, through study of literature and our own pragmatic inquiry, to establish which of these kinds of thinking seem to be in some sense generic and which seem to be more imbedded in particular disciplines. We would then have criteria for determining how to apportion responsibility for developing these skills: some in what we now call "Skills of Analysis/Philosophy" courses, some within specific subject domains.

I am inclined to think that what Presseisen calls "essential cognitive processes" include broad skills of logical reasoning and argumentation (classifying, inferring, working with analogies, induction, deduction, etc.) that can be transferred to many contexts. Given that many undergraduates are grossly deficient in these things, teaching them a vocabularly for these processes is a good thing.

Going further, it seems to me that within majors, very explicit attention should be paid to problem solving, creative thinking, and other processes that mark competence and expertise in the field. I mean that this should not remain implicit and unexamined, but should be explicitly fostered as part of the training in each major. This would relate to categories (2) and (3) in Presseisen's hierarchy.

Finally, there is Presseisen's fourth category. I'm not sure that everyone means the same thing by the "meta" in metacognitive. In this discussion, I would think the term must include the recognition that there are various fields of discourse, each possessing its own vocabularly, procedures, priorities, etc. It is something the anthropologists have helped us understand by comparing disciplines to neighborhoods. It calls our attention to the notion that each neighborhood has its characteristic ways of thinking and expressing itself, but that we can move from neighborhood to neighborhood. The trick is to recognize that to do so one must talk and act like the people on the new street.

Another view of metacognitive may be found in Glaser (1984), who says that metacognitive abilities include "knowing what one knows and does not know, predicting the outcome of one's performance, planning ahead, efficiently apportioning time and cognitive resources, and monitoring and editing one's efforts to solve a problem or to learn." Metacognitive, under Glaser's or my own definition, clearly incorporates a set of skills that are not limited to a specific discipline, but they would seem to be skills that cannot be acquired until some discipline-specific expertise has been gained.

Where should metacognitive skills be taught? This is not an easy question to be resolved by developing a course or two. One context that suggests itself immediately is USM's interdisciplinary requirement. But whether that is sufficient may be doubted, and perhaps this too must in part be the task of the discipline-related trainings. Glaser suggests "teaching specific knowledge domains in interactive, interrogative ways so that general self-regulatory skills are exercised in the course of acquiring domain-related knowledge."

Finally, I would urge that, since we do not have anything like a universally accepted core curriculum model to draw upon and since theoretical approaches are liable to change over time, teaching thinking must remain continuously under discussion and review. Nothing is

more important in this endeavor than a systematic and sustained attempt to ascertain just what the level of attainment of our students is. Here the word "assessment" enters the discourse. Assessment has recently attracted wide interest under the leadership of a few institutions which have sought to use assessment instruments as feedback for the continuous evaluation and improvement of academic programs. Whether or not assessment may have been oversold as a panacea, the fact remains that, unless we wish to proceed in the dark, we must become more systematic about clearly specifying just what "skills" we intend to impart to our students and about verifying to what degree they really are acquiring these skills.

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THINKING AS COMPUTATION

Peter N. Gabrovsky

This work is dedicated to my mother-in-law Cynthia Warrick Kemper who has been and continues to be an inspiration.

The ability to think logically, i.e., to reason, is essential to being human. The quest for understanding the process of reasoning is an ancient human pursuit, the results of which are accounted for in logic. The inevitable question as to whether or not reasoning is mechanizable, i.e., is there a machine executable procedure for reasoning, was not addressed however until the seventeenth century when Leibnitz (1646-1716) set forth the goal of obtaining such a procedure, calling it calculus ratiocinator. Leibnitz's idea sparked a concerted effort to formulate a mechanizable reasoning procedure. Many discoveries followed, and by the end of the nineteenth century there was a widespread belief that Leibnitz's goal was within reach. The state of affairs at that time was especially well articulated by the great mathematician David Hilbert in his now famous address to the International Congress of mathematicians in Paris 1900. The effort to discover a mechanizable reasoning procedure was particularly intensive in the years that followed Hilbert's address, and, at times, it seemed that the solution was just around the corner, but it was not until 1931 that the question was finally resolved. That year a young logician named Kurt Goedel (1906-1978) published an astounding paper from which it became apparent that a mechanizable reasoning procedure does not exist, i.e., reasoning is not mechanizable. Disappointing as it was (for some, anyway) this result, now known as Goedel's incompleteness theorem, has been recognized by many as one of the most significant scientific discoveries ever. The mechanization of reasoning did not become, however, a completely lost cause, because there was still the possibility of obtaining a satisfactory partial solution. Such a solution was in fact apparent in Goedel's doctoral dissertation, submitted to Vienna University only the previous year. In it, Goedel demonstrated that reasoning in a somewhat narrower but certainly not trivial sense, which is detailed later in this paper, is mechanizable. This result is now referred to as the completeness theorem. A procedure for such reasoning, according to the completeness theorem, would, in effect, call for the systematic generation of all proofs until one with the characteristics specified by the goal of reasoning is obtained. Goedel's completeness theorem is of a great value for mathematics, for it characterizes the deductive power of the axiomatic proof method that is used by mathematicians. For the purposes of mechanized reasoning, however, the procedure implied by that result leaves, from a practical point of view, a lot to be desired because the systematic generation of all proofs quickly leads to combinatorially explosive (mechanically intolerable) situation. At around the same time, young Jacques Herbrand (1908-1931), while unaware of Goedel's result, obtained in his doctoral dissertation* at the Sorbonne a theorem which, when combined with the completeness theorem, yields reasoning procedures which are significantly more efficient then those implied by the completeness theorem alone. Roughly, the improvement is in requiring, in general, the generation of only some proofs, and not necessarily all, as the completeness theorem does.

Herbrand's theorem has an enormous practical value, which today remains unsurpassed. For a long time, however, it was not fully appreciated because in practice, the various reasoning

* the paper was dated April 14, 1929, but the defense did not take place until June 11, 1930 because Herbrand was drafted for Service by the French Army.

procedures which are implied by the theorem seemed to require a machine with speed and memory (capacity for storing intermediate results) significantly exceeding what was then technically feasible. Modern computers have alleviated these problems to a great degree and the term programmable (on a computer) has replaced the term mechanizable. In addition, many efficient implementations of Herbrand's theorem were obtained, especially in the last twenty-five years. A notable implementation among these is Robinson's resolution-based procedure. These developments have promoted a new discipline in computer science, called logic programming, which is for studying the issues of implementing reasoning procedures on a computer (where they are referred to as reasoning programs). One of the outcomes of logic programming is the formulation of the so-called declarative programming languages, such as PROLOG. Roughly, a declarative program specifies *what* is the task of the program (the problem), whereas, in the more traditional imperative programming languages, a program specifies *how* the problem is to be solved (giving an algorithm for obtaining the solution). To execute a declarative program is to execute a reasoning program with the declarative program (the "what" part of a task) as its input. Thus, in programming declaratively the programmer can concentrate on describing a problem, and then leave it up to the computer, via a reasoning program, to calculate the solutions to the problem. The advantages of programming declaratively can be illustrated with the following task, called "The Billiard Balls and Balance Scale Puzzle": There are twelve billiard balls, eleven of which are identical in weight. The remaining ball, the odd one, has a different weight. Find which ball is the odd ball, and also whether it is lighter or heavier than the others in three weighings using a balance scale.

With certain syntactic modifications to accommodate any particular declarative programming language, the above described task becomes a program in that language. This program can then be submitted as input to the reasoning program associated with that language in order to obtain all possible (if any) solutions. According to Wos et al. [12], the execution of such a program on an IBM 3033 generated all 40 nontrivially distinct solutions in 22 seconds.

Not surprisingly, declarative programming has found a wide reception in the field of artificial intelligence, especially for developing the so-called expert systems. At the foundation of such applications are, of course, the above-mentioned discoveries of Goedel and Herbrand. In this paper, the statement and the proof of a result which is now regarded as the fundamental theorem of logic programming will be outlined. This theorem is essentially a combination of Goedel's completeness and Herbrand's theorems, and is often referred to in the literature as the Skolem-Herbrand-Goedel theorem to also recognize Thoralf Skolem, who came close to proving the completeness theorem in 1922, while actually aiming in a different direction. The methods which he then introduced are now widely used to produce new proofs of Herbrand's and Goedel's theorems.

Reasoning and Language

On the surface, thinking is a mental process which is perceived by the thinker as the formation of expressions (thoughts) in the symbolism of some medium for communication, such as English (written, spoken), art, music, etc. The expressions are regarded as encodings (denotations) of the thinker's perceptions of the universe and are referred to as (empirical) truths. The subject matter of any particular thinking is (what the thinking is about) the set of all perceptions encoded in that thinking. The encoding, i.e., the interpretation, is assumed to be consistent, which is to say it is independent of context (and of course, of time, as it is a part of the context).

Reasoning, or logical thinking, is thinking about thinking. The expressions of reasoning are referred to as proofs (of statements which are incorporated in the expressions) and are perceptions of a (mental) phenomenon called logical truth. Reasoning involves the use of two media: one to do the thinking with, and the other for thinking about. Such media are referred to as the meta-language and the object-language, respectively. As it happens, in everyday reasoning these two languages are regarded as one and the same, the natural language, by which we mean all means for communication, including written, spoken and other forms of any and all particular languages, such as English, that are known to the thinker. Such dual use of a language is called amalgamation. The amalgamation of the natural language, however, can lead to a confusion (paradoxal situation) as demonstrated by the so called Russell's paradox (named after Bertrand Russell who drew attention to it in 1902). There are several well-known variations to this paradox*, which in its general form defines a set, say S, to be the one which consists of all sets and only such sets, which do not contain themselves as members**. The confusion arises from the question of whether or not S belongs to itself. Indeed, if S were to contain itself, then according to its definition, it does not, and vice versa. The cause of the confusion here is the imposition of a single meaning of the three occurrences of the word "set" in the definition of S. Properly, the meaning of the first occurrence should be according to the meta-language, while that of the second and the third should be according to the object-language. But it is obviously impossible for an expression of a language (here, a word) to have two different meanings in the same reasoning expression, assuming, of course, the consistency of the interpretation of the language. Apparently, it is the unrestricted use of the natural language here as the object language of reasoning that causes the confusion. Indeed, the confusion would have been avoided, by having caused the question in the paradox to become meaningless (bad English), if the expression "all sets, and only such sets, which do not contain themselves as members" was considered as either being meaningless (first approach) or else, denoting something essentially similar, but actually different then whatever is denoted by "set," say "new type of set" (second approach). Following the first approach would lead to a (grammatical) restriction of the natural language referred to as the first-order language. If the second approach were taken without any further restrictions, however, Russell's paradox can be phased again, this time the role of "set," being played by the "new type of set" which now leads, via the first approach, to a restriction referred to as the second-order language. Both restrictions obviously avoid Russell's paradox. The second-order language however, is clearly more expressive (i.e. it has larger subject matter). Third (and higher)-order languages, each successively more expressive and each avoiding Russell's paradox, are obtained by repeatedly taking the second approach, whereby introducing newer "new type of set," and finally taking the first approach with respect to the so-obtained last "new type of set."

Apparently, without any loss of expressiveness, for each order language various more economical sublanguages, classified as being of the same order, can be obtained by excluding words which can be defined in terms of remaining ones. Such sublanguages offer, so to say different basic perspectives, and they are grouped together accordingly into logics (or calculi) such as predicate (or functional) logic (with perspective on properties and functions), com-

*a librarian is asked to compile a bibliography of all bibliographies which do not list themselves. The paradox arises at the point when a decision must be made as to whether or not such a bibliography must contain itself.

**an example of a set containing itself is the set of all sets. The set of all apples on the other hand, is not an apple and thus is does not contain itself.

binatory logic (with perspective on functions only), temporal logic (with perspective on time), modal logic (with perspective on necessity), fuzzy logic (with perspective on probability), etc.

Languages of the First-Order Predicate Calculus

Goedel's incompleteness theorem shows that in general, reasoning about second and higher-order languages is not programmable. His completeness theorem on the other hand indicates that reasoning about first-order languages is programmable. Herbrand's theorem also concerns first-order languages and goes a step further than Goedel's by giving methods which lead to more efficient reasoning procedures. The combinations of the completeness and Herbrand's theorems, as we mentioned earlier, is often referred to as the Skolem-Herbrand-Goedel theorem and is fundamental to the implementation of reasoning procedures. This result and its proof will be outlined in the case when the object language of reasoning is from a certain class of grammatically similar first-order languages, which are commonly referred to as first-order predicate calculus. While the first-order predicate calculus is, in the sense here, a part of the natural language, it is not the same as the common natural language, both in symbolism and in grammar. The introduction of new symbolism is for brevity, while the introduction of new grammar is to avoid having to deal with the intricacies of that of the common language.

Certain symbols are present in each one of these languages and will be referred to them as logical. The logical symbols are divided into propositional connectives and quantifiers. The propositional connectives are: the negation($\neg$), the disjunction($\vee$), the conjunction($\wedge$), and the implication($\rightarrow$): The quantifiers are: the existential($\exists$) and the universal($\forall$). The non-logical symbols of each language will vary with the language (i.e., each set of non-logical symbols corresponds uniquely to a language and vice versa), and for each language they are divided according to the context in which they will occur in the expressions of that language (i.e., their use) into constants, variables, predicates, and functions. The predicates and the functions are further divided according to (the number of their) arity, and in general by n-ary, where $n \geq 1$, we will mean that the arity is n. In a first-order language, the set of the non-logical symbols of any kind may be empty, or finite, or infinte. The expressions of each language are classified (according to how they are formed) into terms and well-formed formulas (or simply formulas) according to the following rules, which for future reference specify other syntactic notions as well:

1. Each constant and each variable of the language is a term.
2. If f is n-ary function and each $t_1,\ldots,t_n$ are all terms then the application of f to $t_1,\ldots,t_n$ is a term, and we will graphically represent it by $f(t_1,\ldots,t_n)$*.
3. If P is n-ary predicate and $t_1,\ldots,t_n$ are all terms then the application of P to $t_1,\ldots,t_n$ is a formula, in this case atomic, graphically represented by $P(t_1,\ldots,t_n)$.

4a. If A is a formula then the negation of A, graphically represented by $(\neg A)$, is also a formula and the set of its parts consists of A and the parts of A.

4b. If A and B are formulas then so are the disjunction, the conjunction and the implications of A and B, graphically represented by $(A \vee B)$, $(A \wedge B)$, and $(A \rightarrow B)$, respectively, and for each one the set of its parts consists of A, B, the parts of A and the parts of B.

*The symbols (,) and, are used as punctuation marks (delineators) for the graphical representation of terms and formulas.

5. If Q and x are respectively quantifier ($\exists$ or $\forall$) and a variable, and A is a formula, then the quantification (existential or universal) of A on x is also a formula, graphically represented by (QxA), and the set of its parts consists of A and the parts of A.

Clearly, each part of a formula is a formula, and furthermore, every formula has finitely many parts. This completes the grammar (the syntax) of the languages in the first-order predicate calculus. A reasoning procedure for any of these languages can now be given. Indeed, such a reasoning procedure, by virtue of being programmable, must concern itself only with syntactic notions (as opposed to semantic ones which pertain to the understanding of a language), and the above outline of these languages provide the necessary syntactic material. In order to state and prove Skolem-Herbrand-Goedel theorem for these languages, however, we must discuss how we intend these languages to be used, i.e., the semantics, which is our next task. The constants and the variables are intended to serve as names of entities. The functions are intended to serve as names of a certain kind of relations between entities—the kind which designates uniquely an entity in such a relation, when the rest of the entities in the relation are given. The predicates are intended to serve as names of relations involving entities in general (functions are thus special kinds of predicates). The atomic formulas are intended to express (individual) perceptions, i.e., empirical truths. The exact nature of the perceptions is not intended to be communicable, for it is presumed to vary from individual to individual, and even to vary with each individual over a period of time (e.g., the perception of a color, the sense of temperature, the taste of any food, etc.) What is intended for communication between individuals (and also to oneself), are certain combinations of perceptions that are recognizable as such, regardless of the nature of the perceptions, and will serve as denotations of logical truth. For each language of the first-order predicate calculus, the formulas denoting logical truth will be called valid. The valid formulas will serve as the expressions of reasoning, so that the formation of a valid formula is what the thinker perceives as reasoning. The value of any reasoning is thus its communicability, which is to say, that the valid formulas are recognized by thinkers, regardless of the individual experience (e.g., regardless of how one perceives each color, the taste of any food, etc.). As the systematic foundation of all formulas in a given language of the first order predicate calculus is programmable, the programmability of reasoning in that language would follow if the determination of validity is also programmable. The definition of validity is complex and for it to be concise requires the introduction of more terminology which is our next task.

By domain (also called universe of discourse), we mean a set. Every domain D determines uniquely a frame (also called subject matter) which consists of:

1. All relations of all arities in D, where by a relation in D of arity n we mean a subset of the set of all n-tuples (i.e., sequences of n many) elements of D.
2. All functions of all arities in D, whereby a function in D of arity n, we mean a specific designation, whereby to every n-tuple in D (the arguments) a single element in D (the value) is designated.

By interpretation of a language L within a frame F we mean an interpretation of the non-logical symbol of L according to which:

1. Each constant and each variable denotes an element of the domain of F.
2. Each n-ary predicate denotes as n-ary relation in F.
3. Each n-ary function symbol of L denotes an n-ary function of F.

If I is an interpretation within a frame F then by domain of I we mean the domain of F.

Every interpretation I of a language L divides the terms of L into sets, each one designated by an element of the domain of I and also divides the formulas of L into two sets, designated by, say T and F, as follows from the following rules:

1. Each variable and each constant is in the set designated by its denotation according to I.
2. If $t_1,\ldots,t_n$ are terms that are in the sets designated by say $a_1,..,a_n$ respectively, and f is n-ary function of L then $f(t_1,\ldots,t_n)$ is in the set which is designated by the value of the denotation of f according to I for the arguments $a_1,..a_n$.
3. If $t_1,..,t_n$ are terms that are in the sets designated by say $a_1,..,a_n$ respectively and P is an n-ary predicate then $P(t_1,..,t_n)$ is in the set designated by T if the relation denoted by P is true of $a_1,..,a_n$ (i.e. the n-tuple $a_1,..,a_n$ belongs to it), else $P(t_1,..,t_n)$ is in the set designated by F.
4. Formulas of the kind ($\neg$A), (A $\vee$ B), (A $\wedge$ B) and (A $\rightarrow$ B) are classified depending on the classification of A and B according to the following table:

A	B	$\neg$ A	A$\vee$B	A$\wedge$B	A$\rightarrow$ B
T	T	F	T	T	T
T	F	F	T	F	F
F	T	T	T	F	T
F	F	T	F	F	T

5. If a formula is of the kind ($\exists$ xA), then it is in the set designated by T, if A is in that set for at least one interpretation of L which may differ from I only in the denotation of x, else it is in the set designated by F.
6. If a formula is of the kind ($\forall$xA) then it is in the set designated by T is A is in that set for every interpretation of L which may differ from I only in the denotation of x, else it is in the set designated by F.

With regard to the above, we note for future reference that determining the designation of a formula from that of its parts is clearly programmable, if the formula is of the kind covered by 4. If a formula is however quantified (5 and 6) it is required explicitly that a certain condition be met with regard to possibly *infinitely* many interpretations, and such a task is not necessarily programmable.

Given an interpretation I of a language L, we say that according to I a term t of L denotes x if t is in the set designated by x, and we say that according to I a formula A of L is true (false) if A is in the set designated by T(F).

For an interpretation I of a language L and a formula A of L we say that A is satisfied by I if A is true according to I. By A is valid in L we mean that A is satisfied by every interpretation of L. Thus, A is valid in L if A is true according to every interpretation of L, and A is unsatisfiable in L if A is false according to every interpretation of L.

Determining Validity

Clearly, if A is valid as a formula of one language, then A is also valid as a formula of any other language. Thus, to determine the validity of a formula A for an arbitrary language, it suffices to consider only the interpretation of the smallest language of which A is a formula, which we will refer to as the language of A. Nevertheless, the task of determining that an arbitrary formula is valid appears to be of enormous magnitude, perhaps even impossible! Indeed, pursuing it in a straight forward manner, it would seem that one has to consider one at a time all possible domains and their frames (finite and infinite) and, for each one, all possible interpretations, even when they are infinitely many as is the case with infinite frames. This approach certainly does not suggest a progammable procedure, for there is no way for a computer to perform infinitely many tasks at one point, before going on to the next one.

The determination of validity of a formula, however, is a relatively easily programmable for a certain class of formulas, called the propositional formulas, which were first formulated by George Boole, Ernst Schroeder and others during the second half of the nineteenth century, preceding the formulation of the first (and higher)-order languages. By propositional formula we mean (in a slightly more general sense then Boole and Schroeder) a formula without any quantifiers or functions, i.e., its non-logical symbols are either constants, variables or predicates. Apparently, in order to determine the validity of a propositional formula A there is no need to consider domains at all (as one might suspect from the observation that being without quantifiers and functions A cannot express any property of a possible domain). Indeed, every interpretation of A determines uniquely a division of a the atomic parts of A into two sets according to their designation under the interpretation (as either T or F), the furthermore, there are finitely many such divisions, for A has finitely many parts. From the assumption that no function symbols occur in A follows that for every division of its atomic parts there is an interpretation of the language of A which designates that atomic parts of A according to the division. From the above two observations it follows that to determine the validity of A, it is necessary and sufficient to consider all divisions of the atomic parts of A. Now, the designation of A from the designation of its atomic parts is, according to an earlier remark, programmable, and from having finitely many divisions to consider, it follows that determining the validity for propositional formulas is programmable.

The propositional formulas, however, are not altogether sufficiently expressive, for it can be shown here that there are valid formulas which are not propositional. This justifies the need for a general solution. As we observed earlier, this appears to be a task of enormous proportions requiring, so it seems, the ability to consider at some point infinitely many different cases (in a finite amount of time) before proceeding to the next point. It is thus quite a surprise that, according to the Skolem-Herbrand-Goedel theorem, there is a way to program the determination of validity (in a sense, the theorem puts a lid on one's imagination for different interpretations). The statement of the theorem, as it might be expected, is quite complex and requires, for it to be concise, the introduction of more terminology, which is our next task.

A formula A is prenex if it is obtained from successively quantifying a quantifierless formula, referred to as the matrix of A (graphically, all of the quantifier of A, if any, are to the left of any of its predicates, and the matrix of A is the part which is quantified by the right most quantifier). By scope of an occurrence of a quantifier in a formula we mean the part of the formula which is quantified by the occurrence of the quantifier. We say that an

occurrence of a variable in a formula is free if it is not in the scope of an occurrence of a quantifier on that variable. We say that an occurrence of a variable in a formula is bound by an occurrence of a quantifier on that variable if it is free in its scope.

The Herbrand universe of a formula is the set of all terms in the language of the formula. By a Herbrand interpretation of a formula A we mean an interpretation of the language of A which satisfies the following:

a) The domain of the interpretation is the Herbrand universe of A.
b) If f is an n-ary function symbol then it is interpreted as the function which has the term $f(t_1,..,t_n)$ as the value for the arguments $t_1,..,t_n$.

By Herbrand base of a formula we mean the set of all atomic formulas in the language of the formula. Clearly, every Herbrand interpretation of a formula divides the Herbrand base according to the designation of its elements and, vice versa, every division of the Herbrand base determines uniquely a Herbrand interpretation of the formula.

We say that a B is a variant of a formula A if B can be obtained from A by successively performing any of the transformations outlined below:

> Replace in a formula all occurrences of a variable bound by an occurrence of a quantifier either with a symbol which is not of the language of the formula, or with a variable of that language, provided that it does not occur bound in the scope of the occurrence of the quantifier, and change the quantifier to quantify on the replacing symbol.

It is easy to see that if B is a variant of a formula A then B is also a formula, and furthermore, A is a variant of B. Apparently, there is a programmable procedure which when applied to a formula A would generate exhaustively a list of all variants of A in a language whose variables can be listed exhaustively by a programmable procedures.

We say that B is a prenex form of a formula A if B is prenex and its graphical representation can be obtained by successively performing on the graphical representation of A any combination of transformations among those that are outlined below:

a) Replace a part by a variant.
b) Replace a part $\neg(QxC)$ by $(Q'x\neg C)$, where Q' is $\exists$ if Q is $\forall$, and Q' is $\forall$ if Q is $\exists$.
c) Replace a part $((QxC) \vee D)$ by $(Qx(C \vee D))$, provided that x does not occur free in D.
d) Replace a part $(C \vee (QxD)$ by $(Qx(C \vee D))$, provided that x does not occur free in C.
e) Replace a part $((QxC) \rightarrow D)$ by $(Q'x(C \rightarrow D))$, where Q' is as in (b), provided that x does not occur free in D.
f) Replace a part $(C \rightarrow (QxD))$ by $(Qx(C \rightarrow D))$, provided that x does not occur free in C.
g) Replace a part $(QxC) \wedge D)$ by $(Qx(C \wedge D))$, provided that x does not occur free in D.
h) Replace a part $(C \wedge (QxD))$ by $(Qx(C \wedge D))$, provided that x does not occur free in C.

Clearly, each of the transformations under b) through h) "pushes" an ocurrence of a quantifier to the left, and furthermore, the applicability of at least one is insured by transforma-

tion a) as long as the result is not prenex. Thus, every formula has a prenex form. An important observation is that a formula is valid if and only if any of its prenex forms is valid. This follows immediately from the relevant definitions and we will not elaborate any further. Apparently, there is a programmable procedure which for any formula will obtain a prenex form.

We say that B is a Skolem form of A if B is existential and its graphical representation can be obtained from the graphical representation of a prenex form of A by repeatedly performing the following transformation:

> Given a formula, remove the first (from left) occurrence of the universal quantifier and the variable which follows it immediately, and then replace every occurrence of that variable (if any) with a constant which is not a symbol in the language of the formula if the removed quantifier was the first quantifier in the formula, or else $f(x_1,..,x_n)$, where f is not a symbol of the language of the formula and $x_1,..,x_n$ are all of the variables (in any order) which occur to the left of the removed quantifer.

The above tranformation clearly reduces the number of the ocurrences of the universal quantifier in a formula and, furthermore, results in a formula. Thus, beginning with the graphical representation of a prenex formula, repeated application of the transformation would eventually result in the graphical representation of an existential formula. It follows that every formula has a Skolem form. It is also important to observe that the transformation results in a valid formula if and only if it is applied to a valid formula. Thus, a formula is valid if and only if any of its Skolem forms are valid. Apparently, there is a programmable procedure which for any formula obtains a Skolem form.

By Herbrand language of a formula A we mean the language whose constants are the terms of the atomic formulas in A, the predicates are the predicates in A and has no functions or variables. It is a stunning observation that a quantifierless formula in any language is also a formula in its Herbrand language and, furthermore, since it does not contain any functions, it is propositional and thus its validity can be determined by a programmable procedure. It is this observation, together with an earlier mentioned one, namely, that there is a programmable procedure which obtains a Skolem form for any formula, that indicate the existence of sound and complete programmable procedure for determining validity from the following statement of Skolem-Herbrand-Goedel theorem:

> A formula is valid if and only if some disjunction of instances of the matrix of some Skolem form of the formula is valid in its Herbrand language.

The proof of the theorem can be divided into two parts as follows. The goal of the first part is to arrive at the conclusion that an existential formula is valid if and only if it is satisfied by every Herbrand interpretation. The "only if" part of the above statement (i.e., in direction $\rightarrow$) is obvious. To see the "if" part, assume that there is an interpretation I which does not satisfy the formula, which we will refer to as A. Let I′ be the Herbrand interpretation of the language of A which interprets an n-ary predicate P as the relation according to which then n-tuple $t_1,\ldots,t_n$ belongs to it if and only if $P(t_1,..,t_n)$ is true according to I. The conclusion that A is not satisfied by I′ is immediate in every case of A except when it begins with existential quantifier (A is existential). We observe that is this case A is also not satisfied by I′ because the collection of all terms designated according to I′ (by the domain of I′, is a subset of the collection of all terms designated according to I (by the domain of I), i.e. I′ is more inclusive than I, and this completes the first part of the proof.

Now, the "if" part of the statement of the theorem follows immediately. We begin the proof of the "only if" part of the theorem with the observation that every Herbrand interpretation of a formula, say A, corresponds uniquely to a division of the Herbrand base of A according to the designation of its member into two sets: the set of the true atomic formulas, and the set of the false atomic formulas. If an existential A is satisfied by a Herbrand interpretation I, then according to the definition of satisfiability (case 5 applied as many times as there are quantifiers in A), there is an instance of the matrix of A, say M, which is also satisfied by I. We will refer to the atomic formulas of such an instance as terminals. Clearly, A above may have more than one set of terminals, perhaps even infinitely many, and certainly not necessarily disjoint. Each terminal set, however, is finite. From the above considerations follows that if A is satisfied by all Herbrand interpretations (i.e. all divisions of the Herbrand base of A), which according to the first part of the proof of the theorem is equivalent to A being valid, then there exist a collection of sets of terminals S, where each set corresponds to an interpretation and vice versa. Let U denote the set of all atomic formulas which are in the sets in S. Obviously, U is either finite or infinite, and we will consider both cases separately. If U is finite then the set of all instances of the matrix of A from which S is obtained, say H, must also be finite because from a finite set of atomic formulas one cannot obtain with the propositional connectives an infinite set of formulas. Each Herbrand interpretation satisfies an element of H, and thus the disjunction of the elements of H is satisfied by every Herbrand interpretation. Being without any quantifiers, this disjunction is valid in the Herbrand language of A and thus we reached the conclusion of the theorem in the case when U is finite. We now argue that U cannot be infinite and this will complete the proof of the theorem. Indeed, assume U is infinite, and let $a_1,a_2\ldots$ be a complete listing of the Herbrand base of A. We note that if K is a set of all Herbrand interpretations which categorize $a_1$through a_n identically, no matter how K determines, via the set of terminals for each interpretation, an infinite subset of U, then K is divided into two sets according to how a_{n+1} is categorized, and furthermore, one of these two sets determines an infinite subset of U, for if both determine a finite subset of U, their K, being their union would also determine a finite subset of U. We obtain a Herbrand interpretation of A, which we will denote by I′, by successively categorizing (as true or false) the above $a_1,a_2..$, so that having categorized every one before a_i, a_i is categorized as true if the set of all Herbrand interpretations which categorized the elements before a_i the same way as I′ determines an infinite subset of U, and a_i is categorized as false if it determines a finite subset of U*. From the preceding remark, it follows that for every a_i, the set of all Herbrand interpretations which categorize the elements preceding a_i the same way as I′ determines an infinite subset of U. But, then I′ cannot have any terminals, because if it does, there being infinitely many, they all must appear before say a_j for sufficiently large j and, thus, the set of all Herbrand interpretations coinciding with I′ on a_1 through a_j determines only a finite subset of U. Thus, I′ doesn't have terminals, which is impossible by assumption. Hence, U must be finite, and this completes the proof of the theorem.

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* A moment's reflection would indicate that the definition of I′ is not constructive in the sense that it does not imply that there is a programmable procedure for deciding how to classify each of the elements of the Herbrand base of A, for these are infinitely many conditions to be checked for each one. Such non-constructive definitions have been challenged by the followers of the so called intuitionistic logic. In this case, the argument for accepting the definition of I′ rests on the so called Axiom of Choice (a similar use of this axiom is in a result known as Koenig's lemma) which was first formulated in 1904 by Ernst Zermelo, and whose validity according to the meta-language of our reasoning has puzzled many until finally resolved by Paul Cohen in 1964.

As we indicated earlier, the theorem implies the existence of a programmable procedure for determining validity in any language of the first-order predicate calculus and thus, reasoning in a given language of the first order predicate calculus is programmable. To be sure, however, that this result is not misunderstood, we note that it does not imply, for example, that there is a programmable procedure for determining non-validity. In fact, Alonzo Church proved in 1936 that such a procedure does not even exist. One of the practical outcomes of Church's theorem is that any complete reasoning procedure may take an arbitrarily long to execute (say in number of steps), for otherwise non-validity would follow. Therefore, a programmer cannot impose a limit on the length of execution of any reasoning program without compromising its completeness.

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SCIENTIFIC LITERACY AND SCIENTIFIC REASONING: DISPARATE GOALS FOR CRITICAL THINKING

Mark Hineline

I. Introduction

Science, or more correctly the scientific method, is conceived to be a mode of critical thinking. According to this view, scientific method provides formal techniques, procedures, and rules for proceeding from observations to generalizations about nature and the universe. When this conception of science leaks down to the pedagogical level, science may be characterized as "*objective* in being freed from personal idiosyncracies. The need for scientific fact to be demonstrable to all persons anywhere and at any time underlies scientific method" (Cowan and Puck, 1984).

Attention to contemporary work in the philosophy, the history, and the sociology of science suggests that conventional approaches to the teaching of science based upon such a conception of scientific method may be naively constructed. Moreover, this reified scientific method may constrain, rather than promote, critical thinking. In this paper, I argue that a reformulation of the pedagogic conception of science and scientific method must be carried out in relation to careful definitions of the terms "scientific reasoning," and "critical thinking." Such a reformulation may go far in speaking to a perception that science pedagogy inadequately prepares students for living and decision making in a culture for which science, and related technologies make substantial contributions to both the problems and the solutions of our civilization. The educator Paul DeHart Hurd (1985) has written of this central concern about the quality of public education in the United States:

> The goal most frequently named by the national studies for the teaching of science is scientific and technological literacy. Literacy is conceived to be the intellectual skills and knowledge essential for one to make responsible decisions or take cognitive action in situations that require an understanding of science or technology ...(p.88).

I shall further argue that a functional distinction must be drawn between scientific reasoning and "scientific literacy" prior to the design and implementation of any teaching curriculum which hopes to aim at the latter of these goals. A hermeneutic approach is proposed as an alternative to the traditional science curriculum; such an approach treats science as an historical process. Through such an approach, it may be possible for the student to gain a perspective on scientific progress and process such that judgments and decisions might rationally be made about both.

II. Defining the Problem

Critical thinking is defined herein as synonymous with what John Dewey (1981) called "inquiry":

> the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole (p. 226).

According to such a definition, critical thinking is problem specific; that is, the process by which the "indeterminate situation" is transformed into one that is "determinate" proceeds according to criteria that are specific to the problem itself because, to continue with Dewey's analysis of inquiry, "logical forms accrue to subject matter when the latter is subjected to controlled inquiry" (p.223). According to such a view, it may be argued, each instance of critical thinking will be an example of "reinventing the wheel" unless the transfer of logical forms from one problem to another can be made whenever it is shown that one problem is like another. So doing gives rise to disciplines. Thus, disciplines owe their existence to analogical or metaphorical relations between subject matter (p. 224).

Which analogies and metaphors are appropriate to a discipline, and which not? And what are the bounds of the subject matter to which the logical forms tranferred through the analogy or metaphor accrue? These are questions that can rarely be settled by continuing to apply the analogy. Instead, inquiry must begin afresh to settle these questions (Toulmin, 1982; Stepan, 1986).

Scientific reasoning, according to this view, is the application of logical forms which, having accrued to an instance of subject matter, are assumed to be equivalently applicable to other *analagous* subject matter. As will be argued below, this assumption comes only with the prolonged training of the perceptions of the scientist. Thus, the outcome of scientific reasoning will appear to the non-scientist as underdetermined by the techniques, procedures, and rules of scientific method unless the metaphor or analogy is somehow taken on faith. Moreover, according to Masterman (1970), analogies and metaphors are applied in science as unproblematic (see also Stepan, 1986, pp. 276-277).

Scientific literacy differs from scientific reasoning in the following way: in its usual connotation, "literacy" is a condition for growth; its meaning suggests an ability to read and to write. In the humanities, it also suggests an ability to recognize such techniques as metaphor and analogy for what they are. The "literate" reader of a text, such as a novel, a poem, or an essay, may then measure the analogy or metaphor for its "fit" or correspondence. As such, literacy is open-ended and open-textured. It permits criticism and may suggest new and better analogies and metaphors. But what of "scientific" literacy? Hurd (1985), in a critique of science education, has said of scientific literacy that it

> has meaning and can be taught only in situations where science or technology interacts with personal or social events. Literacy refers to a level of understanding science that makes it possible for us to use what we have learned to think critically on relevant issues or for interpreting natural events in the world around us (p. 88).

This suggests that science must but viewed in a fuller (interdisciplinary or nondisciplinary but "problematic") cultural matrix, where analogies and metaphors appear as analogies and metaphors, as a prerequisite for scientific literacy. But this is what the science teacher, unlike the teacher of literature, art, music, or history, is not prepared to do:

> In literature, according to Warren Shibles, striking metaphors just come, "like rain" [Shibles, 1971]. In science, however, metaphors are not arbitrary, not merely personal. Not just any metaphors will do. In fact, it is their lack of perceived "arbitrariness" that makes particular metaphors or analogies acceptable as science (Stepan, p. 267, 1986).

Because the metaphors and analogies are not perceived as "arbitrary," they may not be perceived at all (Gavin, 1986). Hence, the problem with science teaching: the teacher does not recognize analogies or metaphors for what they are, and relies upon training or on faith to close the gap between underdetermining evidence and observation, on the one hand, and conclusions and generalizations on the other. The thoughtful, critical student, meanwhile, may recognize the conclusions and generalizations as underdetermined by evidence; but the search for that elusive "something" which would complete the argument is not available. Thus, the student has a series of choices to make, unguided; to accept or reject the science "on faith"; to continue searching for determining evidence (a dead end); or to make a commitment to learning science, a commitment through which the underdetermination will eventually seem to dissolve. In the next section, I discuss the outcome of the last of these choices.

III. Science Education, the Textbook, and Tacit Knowledge

Thomas S. Kuhn's provocative and controversial book, *The Structure of Scientific Revolutions*, describes within its pages the reigning theory of science education. Kuhn recognizes two central means of transmission of scientific knowledge—the textbook and the cultivation of tacit knowledge. After making Kuhn's theory explicit I will argue that such an educational method, however appropriate it may be for training scientists, is utterly inappropriate for educating individuals who will pursue their work and their lives outside of established scientific research traditions.

Although much of Kuhn's theory of science is problematic, the recognition that the scientist is trained to accept a given "worldview," to perceive the world through a "conceptual framework" sanctioned by the scientific community in which she or he is trained and will subsequently work, is difficult to refute. Throughout Kuhn's work, two avenues of education or training are continually emphasized. The first of these avenues is the importance of the textbook to science, for it is through the textbook that facts, laws, and theories of the conceptual framework are transmitted to the student (Kuhn, 1970). It must be underscored that when Kuhn refers to "the textbook," he means *the* textbook—a univocal source for the science which is either the primary source of the facts, laws, and theories or (more often) a secondary compilation of primary sources in which little or no disagreement exists about the foundations of the science. Thus, the textbook constrains criticism of the science inasmuch as it rarely, if ever, presents alternative interpretations. Moreover, this univocality and constraint carries over into the history of the science presented in the textbook.

> For reasons that are both obvious and highly functional, science textbooks (and too many of the older histories of science) refer only to that part of the work of past scientists that can easily be viewed as contributions to the statement and solution of the text's paradigm problems (p. 138).

Kuhn (1977) argues that "the misdirection supplied by science texts is both systematic and functional," adding that "it is by no means clear that a more accurate image of the scientific processes would enhance the research efficiency of physical scientists" (p. 186n).

> Information about how that knowledge was acquired (discovery) and about why it was accepted by the profession (confirmation) would at best be excess baggage. *Though including that information would almost certainly increase the "humanistic" values of the text and might breed more flexible and creative scientists, it would inevitably detract from the ease of learning the contemporary*

> *scientific language. To date only the last objective has been taken seriously by most writers of textbooks in the natural sciences* (p. 186, my emphasis).

If Kuhn is correct that "more than any other single aspect of science, that pedagogic form [the textbook] has determined our image of the nature of science and of the role of discovery and invention in its advance," then it is already clear why scientific literacy eludes educators, for the univocality of the textbook reduces debate to simplistic categories: the student either "gets it" or does not; either accepts the science as presented or rejects it.

But the problem lies much deeper than this, because the beginning student is not only unprepared for scientific literacy; he or she cannot even engage in scientific reasoning. According to Kuhn, the student learns scientific reasoning "by doing science rather than by acquiring rules for doing it." As a label for such learning, Kuhn borrows Michael Polanyi's phrase "tacit knowledge." Tacit knowledge, according to Kuhn, is the essence of scientific training, the end of which is the ability to "see," analogically, in the same way that other members of the specialized group "see." It is to share a gestalt.

> The resultant ability to see a variety of situations as like each other... is, I think the main thing a student acquires by doing exemplary problems... After he has completed a certain number, which may vary widely from one individual to the next, he views the situations that confront him as a scientist in the same gestalt as other members of his specialists' group...He has...assimilated a time-tested and group-licensed way of seeing (p.189).

A very troubling aspect of tacit knowledge, for the educator no more than for the student, is that it cannot be forced. Polanyi (1962) explains that

> ...personal knowledge in science is not made but discovered, and as such it claims to establish contact with reality beyond the clues on which it relies. It commits us, passionately and far beyond our comprehension, to a vision of reality. Of this responsibility we cannot divest ourselves by setting up objective criteria of verifiability—or falsifiability, or testability, or what you will. For we live in it as in the garment of our own skin (p. 64).

Such an analysis of "tacit" or "personal knowledge" leads naturally to a very troubling question: how much is needed? How many textbook problems must the student solve, how many laboratory experiences must she have, before she gains it? To such a question there is no simple answer; this area requires extensive study. What is important is to see that one simply cannot get a clear sense of science in the short period of time available to the non-scientist—which usually consists of two or three courses in high school and a single semester at the college level. This is an insufficient period of time to train perception. It is for this reason that science education is pared back to the memorization of facts, an activity which so many thoughtful people deplore.

To repeat my argument: scientific reasoning, through the use of scientific method, leads to an outcome (a law, theory, interpretation or description) which, though it is not undetermined by evidence, experiment, and observation, is underdetermined by these factors (see, e.g., Rudwick, 1985, pp. 455-456). Moreover, such an outcome appears as underdetermined to the thoughtful student. Some crucial piece of information seems to be missing, and the student does not "get it." The instructor's tacit knowledge or faith, meanwhile, obscures the underdetermination. A student may aspire to such tacit knowledge and so withhold judg-

ment, but if she or he attempts to engage in critical thinking, or inquiry, to transform the indeterminate situation (the underdetermined fact, theory, law, or interpretation) into one that is determinate, his or her efforts may be systematically frustrated.

What is needed, then, is some kind of shortcut—some way either to grasp the analogies and metaphors of a given science tacitly, or to stand away from them and to see them as metaphor and analogy. Or one may abandon the entire game, and engage in a form of nature study through which the student may gain an appreciation for some of the subject matter of science. But it is important, I think, to understand that this last option is not science, should not be called science, and has nothing whatever to do with teaching scientific reasoning or literacy.

IV. Developing a Hermeneutic Approach

It is frequently claimed that a "hands on," experiment-oriented method makes for an effective model for teaching science. Judy Hickman (1984) has correctly observed that:

> Most teachers are not concerned with adding new facts to the science they teach, in formulating new hypotheses, or in verifying existing ones. Instead, they are concerned with what is known. This attitude discourages students from deriving vital and personal learning experiences. The classroom teacher needs to be concerned with the ways in which science may become part of a learning experience and then to determine a method of teaching that properly directs the students' growth (p. 184).

Hickman's technique is an application of John Dewey's pedagogy to science. As such, it does not recognize the significance of analogy and metaphor in science. Hickman (1984) writes of Dewey's testing of the theory that:

> A "test-and-see" attitude prevailed in the Laboratory School, as this is the ultimate teaching method of pragmatism. Students were given a wide range of methodological freedom....Students will attain higher levels of learning when permitted to select the methods. Actions must be modified and given direction by the interrelations of observation and judgment (p. 184).

If by "a wide range of methodological freedom" Hickman means freedom in keeping with a given analogy or metaphor, she does not say so. But it does not matter; because she does not display an awareness of analogies and metaphors in science, Hickman's proposed method can lead to one of two difficulties: either (1) there are analogies through which "actions must be modified and given direction," but of which neither teacher nor the student is aware of; (2) there is no analogy, meaning that the modification and direction given is itself unmodified and undirected except as the teacher sees fit, but in contradistinction to scientific practices except as naively understood. In the latter instance, a naive realism on the part of the teacher can easily lead (for example) to a Baconian picture of scientific activity which virtually all philosophers of science recognize as untenable.

Such a Deweyan approach to activity in the classroom is, however, at least an improvement on the standard approach of using experiments in teaching. This approach, although itself an improvement on mere memorization of material, is nevertheless flawed to the extent that it is used without an awareness of the analogies or metaphors which inform the particular experiments.

To understand why, we must briefly adopt Kuhn's term "exemplar" as a replacement for "analogies and metaphors" (Kuhn, 1970, 187-191). Kuhn argues that exemplars are not corrigible by the experiments by which they are, in part, constituted. Conversely, the results of experiments must be interpreted univocally through the logical structure of the exemplar and have, therefore, a tautological relationship to the concepts they demonstrate. Put another way, the replication of an experiment for teaching purposes is little more than propaganda for the exemplar, which is irrefutable without a concommitant understanding of the exemplar as exemplar. Nothing in the experimental approach as such leads to such an understanding; the understanding must be grafted on.

It will be seen, then, that neither the strictly Deweyan model, nor the "experimental" model, aim at scientific literacy as it has been defined in this paper. The Kuhnian model of science pedagogy has been shown also specifically to eschew scientific literacy as an aim. A fourth model proposed by David Stenhouse, which assumes Kuhn's position as a starting point, is worth looking at (Stenhouse, 1986). In this model, the conceptual shifts through which children pass as they grow are compared to the Gestalt switches of scientific revolutions described by Kuhn. The author generalizes this observation in such a way that the entire teaching effort in the science classroom becomes a movement from the Piagetian stage of "children's science" (the paradigm held by the child) to "teacher's science." Such an approach, though it does have useful elements, fails on two counts. First, there is no attempt to deal reflectively with the conceptual shift from children's science to teacher's science; if the parallel between the conceptual shifts of science and those of children are close enough in kind to be useful for a teaching model, surely they are close enough that children should be made aware of having accomplished what has been hailed as the most rational process our species has developed. Second, "teacher's science," as an end of the process seems premature. Teacher's science, to the extent that it is knowledge of the facts, laws, and theories of sciences, is not science. The model emphasizes closure at the level of "teacher's science" and is therefore not a model for developing scientific literacy.

Perhaps there are several models which may aim at such a literacy; I shall propose one that may take several forms. The model begins with John Dewey's (1986) belief that:

> It would be much better to have fewer facts and truths in instruction—that is, fewer things supposedly accepted—if a small number of situations could be intellectually worked out to the point where conviction meant something real—some identification of the self with the type of conduct demanded by facts and foresight of results. The most permanent bad results of undue complication of school subjects and congestions of school studies and lessons are not the worry, nervous strain, and superficial acquaintance that follow...but the failure to make clear what is involved in really knowing and believing a thing (p. 178).

In the Deweyan exposition of method, such a "making clear" leads to an attitude of "intellectual thoroughness" through which the student takes responsibility for knowing and believing. Both John Dewey and Thomas Kuhn tell us that to know and believe a thing involves a serpentine path through a changing field of beliefs and knowns; we have evidence that the changes in beliefs and knowns is a process which the student can understand through self-reflection upon conceptual shifts that are native to the student's own growing process. Thus, Dewey's (1966) belief in intellectual self-awareness can be met in principle if a method be

developed by the teacher with intellectual self-awareness as an aim. To begin with science in its current form is to abandon such an aim; Dewey wrote that:

> To the non-expert...this perfected form [of science] is a stumbling block. Just because the material is stated with reference to the furtherance of knowledge as an end in itself, its connections with the material of everyday life are hidden (p. 220).

The atom, whether it is understood today as a theoretical entity, a social construct, or as the fundamental "real," has a long and circuitous history. Its currency as a conception is a response to questions about its form raised in response to questions about the adequacy of the mechanistic conception of atoms; the latter was a response to questions about the ultimate, indivisible form that matter may take—a question that first appears in a logically coherent form with the atomists in pre-Socratic philosophy. In short, the atom has a human history. As it did for the pre-Socratics, the question of ultimate particles of matter may arise from the experience of the learner whether stated crudely or concisely.

Only by making use of the experience of the student and by allowing the conceptual shifts of childhood to modify that experience, and in the process making the student aware of the shift can the actual ethos of science become a part of the habits the child gains through formal education. Only when this is accomplished can the student be called scientifically literate, for the habits become open-ended and open-textured; they do not fail utterly when faced with novel situations, or lead inevitably to error due to unrecognized novelty. This is what Dewey (1966) meant when he wrote that:

> An experience, a very humble experience, is capable of generating and carrying any amount of theory (or intellectual content), but a theory apart from an experience cannot be definitely be grasped as a theory. It tends to be a verbal formula, a set of catchwords used to render thinking, or genuine theorizing, unnecessary or impossible (p. 144).

Where does that experience begin? Dewey (1966) speaks briefly in *Democracy and Education* of a "chronological method" that "begins with the experience of the learner and develops from that the proper modes of scientific treatment."

> ...by following, in connection with problems selected from the material of ordinary acquaintance, the methods by which scientific ment have reached their perfected knowledge, [the pupil] gains independent power to deal with material within his range, and avoids the mental confusion and intellectual distaste attendant upon studying matter whose meaning is only symbolic (pp.220-221).

The "methods by which scientific men have reached their perfected knowledge," we have seen, is more complicated that Dewey supposed. But this does not refute Dewey's method; it enriches it. What will be proposed below is a process pedagogy: the presentation of old truths and new truths in a chronological sequence such that the student must "inquire" and, in the resolution of doubt reconstruct—"discover"—the facts, laws, and theories of science for her or himself.

Let us begin where the student is, by examining what the student's conception of the universe has in common with science at any point in its history. If the child spontaneously asks: "can the position of an electron and its speed be measured simultaneously and with certainty,"

this shall be our beginning, and we will save considerable time. But this is unlikely. For very young children, an Aristotelian picture may coincide with the child's conception; students may be prepared to start earlier, in myth or later, depending upon the understanding they bring with them. Clearly, the starting point for teaching science is difficult to determine and may be the most substantial problem the teacher will attempt to solve. Until experience has settled the question, such starting points may have in them elements of arbitrariness. But having selected a beginning point, the teacher asks herself: what is the paradigm? What metaphors are used in the paradigm? What counts as evidence, and what does not? What genuine experiences can my students have in a contracted period of time such that they may apply the paradigm? What discussions of the historical context of the paradigm will be useful in making the paradigm meaningful and clear? Finally, how far afield of the actual history of science does the teacher go in allowing for the proposal of new paradigms and the acceptance of a new one? Having answered these questions, the teacher prepares a syllabus combining reading, field and laboratory experience, discussion, lectures concerning concepts, and lectures concerning context. This proposal calls for the teacher to be something of a scholar, working in a number of disciplines. He or she must be part sociologist, part historian, part philosopher, part scientist. Each part is fallible. Taken together the possibilities for error are enormous; thus, the teacher must give up all pretense of being the final arbiter of truth in the long run, though she or he may feign commitments to truth which will change throughout the course. That earth, air, fire, and water are the four elements of which the world is composed will be presented as a true statement, not as "once believed but now known to be false."

If determining the starting point is the most difficult part of the program, this explicit fallibilism is a close second; strategies must be worked out to permit the student to "play the game." So contrary to regular practice is the method that without such a strategy the student may react pathologically. With that caveat acknowledged, it may be stated that the teacher takes on the mantle not of truth but of exemplars in a historical, or chronological sequence. As the sequence is played out, anomalies accrue (with or without the teacher's intervention) leading to crisis, proposal of new analogies and metaphors, revolution, resolution, and a new exemplar. Interventions by the teacher should be made only as needed to direct students toward more sophisticated, aesthetic, and comprehensive analogies and metaphors, although this will vary in the degree that the teacher uses actual historical examples through which to "color" the contexts of paradigms.

Such is the hypothesis. The thoughtful critic of such a program may find the program flawed or promising in principle; it remains to be seen whether it can or will work in practice.

Postscript

A course in science as proposed above was attempted by the author at Mt. Ararat School, SAD 75, in Topsham, Maine, through the spring 1987 semester. In this course, entitled "Theories of the Earth," students confronted problems about time (how much time is there? Is time real, or a social construction?); classification (does classification tell us about things—nature—or about ourselves as classifiers?); and difficulties in distinguishing the "real" constituents of science from a science's "heuristics." These were all presented as part of an overall question: how old is the earth, and how can we know?

It is too early for a comprehensive evaluation of this course, which is still being taught to two sections of high school juniors and seniors as this paper goes to press. In addition, a

series of variables will make evaluation difficult. But preliminary interviews with students suggest that such a program of teaching is possible, as long as the expectations of the teacher are clearly and carefully delineated. As may be the case with many critical thinking programs (see Grzelkowski and Hineline, 1987), the goal-orientation of "good" students must be taken into consideration when designing a course curriculum aiming at scientific literacy.

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ART-MAKING AND THINKING

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The request for papers for the Russell Chair Symposium, "What Socrates Began: An Examination of the Intellect," offered some suggested topics as examples of the kind of inquiry appropriate to an exploration of thinking. Insofar as my adult professional life has largely consisted of studying and teaching art, making art, learning about children and their art, and training prospective art educators, it is not surprising that one of the suggested topics which caught my eye was titled, "How do the arts influence thinking?" But it was actually the wording of this particular question which intrigued me. "How do the arts influence thinking?" The syntax was puzzling because I recognized that I did not conceive of the arts and thinking in precisely the way that the question seemed to relate them. "Thinking," on the one hand, seemed to be separate from a field of study or discipline—"the arts." The arts seemed to be given a capacity to exert power over the action of producing thoughts—thinking. This unfamiliar combination, "How do the arts influence thinking?" has prompted numerous ruminations because, like much of what spurs us to action, something felt wrong.The problem for me was located in what seemed to be a rather disembodied notion of thinking, which was not itself imbedded in a form of thought or discipline.

This paper argues for a conception of art-making and thinking as inextricably intertwined in ways that are often unnoticed, ignored, or even deprecated. I hope this examination serves to expand our understanding of what participation in the arts entails cognitively. I believe it also will help to enrich our perspectives on thinking and what it is. I am of the persuasion that thinking is akin to knowing, and knowing is the dense, inevitable purpose of our lives. Who are we and where are we and what do we come from and where are we going? Our lives, and indeed our schools and education, are dedicated ultimately to the exploration and understanding of those questions. We know that through the arts, people have searched and researched some of the most vital responses to these profound queries. It seems important to recognize that the arts have represented an important kind of thinking in human history. At present, it is also significant to make some effort towards "physicalizing" the process of thinking, removing it as the sole province of linguistic analysis, psychology, and sometimes even philosophy and logic, all fields which have a tendency to overlook the body. Making art and the kinds of thinking generated by participation in the artistic process are first reminders of the sentient aspects of our existence. The senses—tactile, visual, aural, and kinesthetic—are at the heart of both thinking and art-making.

In 1926, the British philosopher R.G. Collingwood described art-making as an act of thinking itself. "To be an artist is to create for oneself a world of imaginary objects whose function is to express to oneself one's own mind" (p.195). This paper explores the value of art as an activity in education. Like Collingwood, the education I am describing is not the training of professional artists but rather the general education of children and adults, the education of novices in the arts. What is the intrinsic benefit of art activities for an individual, and for a community of individuals? In what ways are we thinking while we are making art? At this particular time in educational history, what are the special burdens of exploring these ideas? What might this exploration suggest about what we are doing when we make or do something artistic? In what ways should the study of the arts focus on the process of making art? What, particularly, do we learn from the artistic process which is unavailable from other educational endeavors?

Assertions have abounded in this century, especially in American education, about the importance of the arts for learners. The legacy from the progressive education movement fifty years ago, and perhaps a misreading, or even non-reading, of John Dewey, has placed ill-defined notions of "creativity" and the arts, at the center of "learning by doing." Educators, using the model of the artist for the student, have since stressed studio art activity as the content of art education, but have also simultaneously embraced a rather nonintellectual view of that artistic process. This view of the child-as-artist has not been a particularly successful rationale for strengthening school art programs. Art, at present, is not a major part of American schooling. In recent decades, art advocates have perpetuated the exhortations of "all the arts for all the children" but have not provided an explanation of the particular contribution of studio programs for children which went beyond the progressive educators' "creativity" rationales. More recently, educators, museum, and foundation officials—especially the John Paul Getty Trust (1985)—have been highly critical of exclusively studio-based art classes in schools. They have urged instead the study of art criticism and art history, primarily to strengthen the "intellectual" component of art study. While it is not the province of this paper to debate the relative merits of the content of art programs, it seems useful and timely to reflect on the tenacity of the artist-model for art education, and to examine any value that model may have so as to inform our future art curricular choices more potently.

Doing, making, constructing—the physical activities of the hands, of the body, have been undervalued in education. The inheritance of a Platonic and Cartesian view of knowledge has prejudiced us that abstract reasoning is a "higher" form of knowing than that available from direct, perceptual purview. Vernon Howard (1982) suggests that even Piaget, with stage theories that go "from concrete to formal operations" further confuse our understanding of the role of action or activity in learning. These ideas perpetuate a myth of a separation of mind and body. Not only do these views have a tendency to minimize the value of art activities in education, but they wrongly narrow our vision of ideas as imbedded, wedded, interacting with, from, and towards actual physical experience. John Dewey's keen understanding of the interrelationship of inquiry and activity is well summarized by Howard (1982) when he states that for Dewey, "Quite literally, ideas are plans of action" (p. 133).

Both John Dewey and William James, like their Pragmatist colleagues, shared a view of reality which is rich with incident and stimulation, at a given physical place and point in time, a "booming, buzzing confusion" out of which we as individuals strive to make some sense. In his 1907 *Pragmatism*, William James captured the human capacity for reflection and selection at a given moment in time. "Every hour brings its new precepts, its own facts of sensation and relation, to be truly taken account of; but the whole of our past dealings with such facts is already funded in the previous truths" (p.109). The view of the person in James's work takes on a creative or inventive dimension which is not unlike the actual work of artists. He suggests that we make truth and reality out of ourselves and the very experiences we undergo. The person at the center of James's conception of human consciousness is a creature interacting with the environment in a dynamic manner—"No reception without reaction, no impression without correlative expression" (James, 1901, p.22). James described a person not only engaged in mere activity and response, but also as a thoughtful decision-maker. In an aesthetics notebook (n.d.), James wrote that the "analogy between art and life is that by both, results are reached only by selection and elimination." It is of course no accident that William James began his career as a painter and his works are rich with the sensibilities that came from the art-making process he intimately experienced.

> But all the while, the world we feel and live in, will be that which our ancestors and we, by slowly cumulative strokes of choice, have extricated out of this, as the sculptor extracts his statue by simply rejecting the other portions of the stone. Other sculptors, other statues from the same stone! Other minds, other worlds from the same chaos (James, 1983, p. 51)!

John Dewey was also explicit about the parallels between art and life and said in *Art as Experience* (1934):

> There is another matter that is common to the substance of all works of art. Space and time—or rather space-time—are found in the matter of every art product. In the arts, they are neither the empty containers nor the formal relations that schools of philosophy have sometimes represented them to be. They are substantial; they are properties of every kind of material employed in artistic expression and esthetic realization (p. 206).

Then later, in discussing William James, Dewey added:

> As with other properties of substance of which we have spoken, the fine arts seek out and elicit this quality of all the things we experience and express it more energetically and clearly than do the things from which they extract it. As science takes qualitative space and time and reduces them to relations that enter into equations, so art makes them abound in their own sense as significant values of the very substance of all things (p.207).

If our mentors be Collingwood, Dewey, and James, it is important to add some present-day voices as well.

The colleagues at Harvard Project Zero at the Harvard Graduate School of Education have, since 1967, pursued basic research in arts education under the leadership of philosopher Nelson Goodman. Goodman, in a special March 1983 edition of *Art Education* devoted to "Art and the Mind," recommended to all who are interested in the arts and cognition, said:

> ...cognition includes learning, knowing, gaining insight and understanding, by all available means. Developing sensory discrimination is as cognitive as inventing complex numerical concepts or proving theorems. Mastering a motor skill involves subtle kinesthetic distinctions and connections. Coming to understand a painting or a symphony in an unfamiliar style, to recognize the work of an artist or school, to see or hear in new ways, is as cognitive an achievement as learning to read or write or add. Even the emotions function cognitively: in organizing a world, felt contrasts and kinships, both subtle and salient, are no less important than those seen or heard or inferred (p. 34).

I refer you to Howard Gardner's *Frames of Mind* (1983) for a new definition of human intelligence(s) or to David Perkins' *The Mind's Best Work* (1981) for a fascinating exploration of the ways that creative thinkers in all the arts work. We should also not neglect Rudolf Arnheim, whose life's work has been dedicated to looking at the ways that "Perceiving, Thinking, and Forming" (1983, p. 9) are interdependent. Arnheim's work has a keen sense of the tactile. Andrew Harrison is a British philosopher who has written *Making and Thinking* (1978), a study of intelligent activities which looks at length at the arts.

The special challenge today, though, is how to articulate the nature and possible benefit of studio art activities in education and avoid the perils of the past. Care must be taken to avoid overly romantic views of the artist. We must escape a confusion of activity and merit—just because we make something does not mean that it is good—and not neglect qualitative judgments about the products of our endeavors. We need to capture an authenticity about the artistic process: its spontaneity and rigor, its risks and benefits, its experimentation and craft. We need to examine ways to encourage students to pay attention to their personal insights and feelings through art, but avoid a cult of the individual as "self-expression." We must seek ways to capture a reliable essence of "creativity" without surrendering our intellectual capacity to analyze and understand human experience and expression. We must relinquish our exclusive claim on "creativity" as artists, and share notions of that human quality with our colleagues in the sciences and humanities, but remain clear about the precise role of the arts in the educational enterprise.

In this paper, I have in mind examples from the visual arts, but with a supposition that, for the most part, comparable points might be made using music, dance, writing, or theater as studio activities designed for learners. I will focus on only four aspects of artistic activity which are particularly relevant to education: 1) physical or temporal engagement; 2) a way of thinking; 3) innovative intimacy; 4) the social dimension of an audience or standards. Other important aspects could be included—motivation or learner-interest, for example—but for this discussion I will concentrate on these four.

The doing or making of art usually involves a physical activity in time and space. This alone could not qualify an endeavor as necessarily artistic, but it is interesting to note how few aspects of schools truly challenge a student's physical being. Art-making does require an engagement of perception and attention which connects and binds the artist with materials and with a shaping process. The making of art insists that at some point we concentrate, focus, and study. Dewey (1934) was correct in proposing that an aesthetic experience is the prototype of a complete human experience. It may also be that an art-making experience is a prototype of a complete human learning incident. The commitment of body/mind/feelings in a particular manner at a distinct time and place, the necessity for involvement, the judgments, guesses, reflections, trials and errors, the practice, the action and the interaction which are described by Vernon Howard (1982) in his book on *Artistry*, convincingly reveal the remarkable similarities between the artistic and the learning processes. Even though not all art-making involves a "physical artifact," the art process necessitates an acute temporal awareness, a "present-ness" which is vital to understanding or making something new. It is especially at work in making things well. Art-making may be a way to experience and practice genuine engagement in the present.

Collingwood (1926) suggested the vital connection between the experience of art-making and the "birth of thought itself":

> The thought that before utterance lies obscure and unrealised in the dark places of the soul, in the "chaos of preordination and the night of its forebeing" comes into living existence in the act of expressing it: a person who has not, somehow and in some kind of language, said what he means, does not yet know what he means, and strictly cannot be said to have a meaning (p. 196).

The practice of art gives us the opportunity to think in a particular way. It is a distinctive method of understanding which necessarily results in evidence of that understanding. Our systems of education purportedly are designed to help students develop their knowledge of the world. We construct our knowledge of the world through the forms of thought or languages

which our culture shares with us. Art provides a way to give form to experience as it shapes our understanding of experience itself. The structure of understanding which is available from an art-making experience enriches our capacity to think, to know, and to experience life more fully. David Best, whose recent book *Feeling and Reason in the Arts* (1985) shows a clear understanding of the role of artistic languages in developing thought, showed how practice in the arts gives us the opportunities to extend our potential for human expression:

> But a person with only trite forms of expression is a person who is capable of only trite experiences...The crucial educational point here is that if people succumb to the pressure to limit themselves to the circulating library of cliche forms of expression, then their capacity for individual thought and emotional experience is commensurately limited (p. 72).

The Gulbenkian Foundation in Britain, asserted in a 1982 publication, *The Arts in Schools*, "The arts are not only for communicating ideas. They are ways of having ideas, of creating ideas, or exploring experience in particular ways and fashioning our understanding of it into new forms" (p.22). Schools should be a place where students can practice the arts as a way of thinking.

Another contribution of art as an activity has to do with the fact that the studio process is a personal or intimate experience. It necessarily involves an individual, participating in a process of making. In peak examples, an artist exercises control over materials, demonstrates competence with artistic form, but primarily shares his or her own particular personal vision or thought through the act of making. In the process of doing art, we define our limitations and boundaries. While it is important to avoid a narcissistic preoccupation with ego or self, it is an unmistakable fact that, in a drawing for instance, the artist makes the line on the piece of paper. The artist thereby exercises a special kind of control or influence on the world which in contemporary terms might be called "empowering." Vernon Howard (1985) has said, "Not until the task becomes mine does it come alive in thought and action" (p. 14).

If we left the discussion here, we would have ignored some essential accents to the personal experience of making art which are critical: the disciplines of the art forms themselves, and an important element of innovation. David Best (1985) said it well:

> In the arts, language and many other aspects of human life the possibility of individual development in thought and experience, so far from being restricted by, actually depends upon, the learning of disciplines (p. 73).

In describing the arts as forms of thought, it also follows that there are traditions, examples, and standards which are the peak models from which to learn. Even novices must have a glimpse of public exemplars to assist in the appropriation of a new language, however personal the expressions might be. The relative merit of the results of the novice's artistic process can certainly be assessed by seeking a comparison with the peak examples in the discipline, but it seems more useful to concentrate on some of the ways in which the products are original for the maker, in relation to the maker's peers, as well as to a larger frame of reference.

The philosopher Gilbert Ryle (1967) appreciated that invention is always part of the learning process and it is no accident that he here uses the example of an artist to illustrate his point:

> The poet composes a sonnet, taking care to adhere to the regulation 14 lines, to the regulation rhyming scheme, to the regulation metrical pattern, or else

> perhaps to one of the several permitted patterns—yet, nonetheless his sonnet is a new one. No one has ever composed it before. His teacher who taught him how to compose sonnets had not and could not have made him compose this sonnet, else it would be the teacher's and not the pupil's sonnet (p. 114).

Ryle captures the dual qualities of innovation and intimacy which seem a part of both learning and creativity. When we ascribe the word "creative" to a human activity, we mean to highlight a "newness" to the event or example. The languages of the arts provide opportunities to practice innovation in a personal way, to try making or shaping something for the first time, to find particular expressions which bear the personal mark of the maker. Studio art activities provide the occasion for a rare innovative intimacy in schools. Invention is part of art and thinking.

The final and perhaps the most important reason to consider art-making as a worthwhile activity in schools has to do with the fact that (at least from age six on) the creator of a work begins to take into account an intended audience for that work. The artist begins to adopt the role of critic as well as maker in the process. Art-making is indeed a process which encourages self-awareness. But as the artist explores ways to become more articulate and gain understanding, he or she also begins to consider the audience who will interpret the evidence of that understanding. Thus, the artistic process, through the art work itself, has the potential to move the artist from a personal dimension to a social or shared one. If the results of our work are to be of value, we must seek the standards for that merit in the public sphere. Ultimately, we look for ways to offer our works for public critique. The process is strikingly social. In a school situation, the potential benefits of these shared aspects cannot be underestimated. Dewey (1934) helps us to return full circle to the physical experience of making, when he discusses the artist's final decisions:

> Until the artist is satisfied in perception with what he is doing, he continues shaping and reshaping. The making comes to an end when its result is experienced as good—and that experience comes not by mere intellectual and outside judgment but in direct perception (p. 49).

Students can be encouraged—and this is where good teaching is essential—to be rigorous in their self-critique so as to form something really well. The student learns a paradigm of objective, qualitative form in good studio activity, which actually encourages a kind of thoughtful detachment. This seems the very opposite of self-indulgence.

Art-making gives us the chance to try, to play, to work at shaping a vision. In the context of the school environment, it gives students the chance to see the multiple responses by others to artistic problems and activities. Art-making encourages diverse solutions to common problems, a dual notion of the one and the many, simultaneously. Dewey (1934) allowed that, "Expression strikes below the barriers that separate human beings from one another" (p. 241). The rich world of art offers glimpses of ourselves, of others, and of the world. It can help to show us that we are not alone and that there are many paths to the truth. Art-making gives us a way to be part of the past, the future, and most decidedly the present.

These statements about the particular benefits of studio are activity for novices do not mean to deprecate the rich knowledge which is available from the study of art works through the methods of art history and criticism. It could be that art historical inquiries would be even more vital if in their analysis they attended more to the actions of the artist in actually constructing a work of art.

The practice of art in schools offers the students the potential for an uncommon physical and temporal engagement. Art activity is also a way of thinking and can address the rights of children to have access to a variety of forms of thinking. Art-making can prompt a response which is both intimate and innovative. The artistic process includes a social dimension, too, embodied in concepts of audience and standards. Art-making as a thoughtful enterprise ultimately involves excellence. Most of all, art as an activity may be the very model of human "learning, doing, and thinking." To quote Eisner (1983) when he summarized Bronowski's point of view in *The Ascent of Man*, "The hand is the cutting edge of the mind" (p. 24).

The character of thought available from an imaginative art-making experience for students is exemplified in the visual evidence offered here. I am grateful to Jamie Johnston, furniture-maker, for permission to describe his creative, problem-solving art lesson. During a special craft workshop for high school students at the Haystack Mountain School of Crafts in Maine, Jamie gave each student in his workshop a piece of wood measuring 2" by 6" by 48." Students were then asked to design and construct an object suitable for sitting—a chair, a bench, a stool. The students had little or no previous woodworking experience. Jamie offered instruction in fundamentals of construction, tool use, and basic woodworking techniques. In the three-day workshop, each student then produced an original, handcrafted work. A sampling of the results pictured here shares the rich connection between working with the hands, the mind, and the imagination. From intelligent teaching, through attentive learning, the student experiences art-making and thinking as a fusion of thoughtful activity.

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Author Notes

I wish to thank Vernon Howard, my advisor at the Harvard Graduate School of Education, for his thoughtful criticism of an earlier version of this paper, Sheila Bohlin for permission to use her photographs, and the University of Southern Maine Educational Media Services for preparation of the photographs for reproduction.

Figure 1. Designed by Leif Ekholm, Lincoln Academy.
Photo by Sheila Bohlin

Figure 2. Designed by Elizabeth Berry, Lincoln Academy.
Photo by Sheila Bohlin

Figure 3. Designed by Christine Prosser, Skowhegan High School.
Photo by Sheila Bohlin

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THINKING AUTOBIOGRAPHICALLY

E. Michael Brady

The process of thinking is the process of defining identity.
Ayn Rand

The Hasidim tell a story. Once upon a time, in a faraway village, there lived a rabbi. For years this rabbi had been the teacher and leader of his people, and for years he would intervene at times of crisis in order for the crisis to pass and his people to be saved. Whenever a crisis approached, be it famine, plague, or an enemy, he would go to a special place in the forest that lay outside the village. When he reached this place, he would light a fire and say a prayer. This ritual was always sufficient. The crisis would pass.

When the rabbi died, one of his sons, who was also a rabbi, took his place. In times of calamity, he, too, would go to the forest and light a fire, but he did not know the prayer uttered by his father. So, upon lighting the fire, he would return to the village. This, too, was sufficient. The impending crisis passed.

And the day came when this man died and his son became the village rabbi. When his people were threatened, he would go to the special place in the forest. But he neither lit the fire nor said the prayer. Still it was sufficient. The crisis passed.

Finally, time passed and a fourth rabbi, the great-grandson of the first rabbi, became the town's spiritual leader. And when his people were threatened, he did not say the prayer or light the fire or even go into the forest to the sacred place. He simply remained home, gathered his family and the people from the village around him, and told the story of his great-grandfather, and grandfather, and father. This was sufficient. The crisis passed.

The story was sufficient. The last rabbi knew this. He knew the power that telling a story had. He knew that thinking, along with his family and village, about their shared past and expressing this would in itself be a powerful act. He and his people could define and defend themselves through recalling their past, and their various threats, and the rituals that had always saved them.

In the broadest sense of the term, the fourth rabbi was an autobiographer. He created a mirror in which he reflected his own past, his own heritage, as well as that of those with whom he shared this history. As the literary critic Georges Gusdorf suggests, in creating such a mirror in which an individual reflects his own image, one in fact engages in an autobiographical act (Gusdorf, 1980).

At the center of autobiography is the Greek word "bios," meaning life. More exactly, however, "bios" is defined as the course of a life, or lifetime. But this immediately raises some interesting and difficult questions about autobiography. If "bios" is the course of life, and if this course is already spent and past, then how is it going to be made present again? Can it be recaptured, and if so, how? Can that which is past and no longer living be restored to life?

Autobiography is an individual's attempt to answer these questions, to raise them to the level of conscious thought and discourse, and to redeem "bios" for the present. Therefore, it is the thesis of this paper that autobiography, the act of drawing a self-portrait with words, is a vitally important method of facilitating and enhancing both the processes of human thinking and of defining human identity.

Autobiographical acts enable individuals to think about themselves and their world in three different ways. I call these the remembered self, the ordered self, and the imagined self.

The Remembered Self

The form of thinking that is most associated with autobiography is that of reflection upon the past. While it is true that autobiography does attempt to remember past events, human memory is a complex phenomenon and represents much more than recollection and retention. It has been said that memory is a continuum ranging from vague, dim shadows to the brightest, most vivid totality (Myerhoff, 1980; Olney, 1980). It may offer opportunity not merely to recall the past but to relive it, in all of its original freshness, unaltered by intervening changes and reflections. Such moments can be pinpoints of the greatest intensity, when a sense of the past which has never been truly lost is experienced. With this kind of memory, according to the anthropologist Barbara Myerhoff, the diffuseness of life is transcended, the sense of duration overcome, and all of one's self and one's memories are felt to be valid (Myerhoff, 1980).

If "bios" is a process, then it possesses a certain shape, and we might say that memory is the thread that describes that shape. The thread usually remains hidden, unconscious, unknown to the individual until the time when it rises to consciousness, after the fact, to present itself to the individual as recollections. Thus, he can trace back with a kind of Ariadne's thread, to discover the shape that was all the time gradually and unconsciously forming itself. In this way, the memory of the autobiographer provides him with what James Olney calls a "conscious consciousness" (Olney, 1980, p. 252).

Myerhoff uses the term "re-membering" (Myerhoff, 1980, p. 74-77), bracketing it by a hyphen to distinguish it from ordinary recollection. Re-membering is the aggregation of one's members, the figures and events that properly belong to one's life story. It brings together one's prior selves and the significant others without which the story cannot be completely told. In this way, the fourth rabbi re-membered himself in the context of his three predecessors. Such re-membering is a purposive and significant unification, different from the passive, continuous, fragmentary flickerings of images and feelings that accompany other activities in the normal flow of consciousness (Myerhoff, 1980).

Memories and present reality bear a continuing, reciprocal relationship, influencing and determining one another ceaselessly. Memories are shaped by the present moment and by the specific psychic impress of the remembering individual, just as the present moment is shaped by memories. The "now" of consciousness is as it is because of the interrelationship between past events and memories of those events. Following his observation that memories are an intrinsic part of the actuality in which they emerge, Erik Erikson goes on to say that memories serve as a connector of meaning between what happened once and what is happening now (Erikson, 1966).

Within this context, we might look upon autobiography as a second reading of human experience. And, as Gusdorf has said, "it is truer than the first because it adds to experience itself consciousness of it" (Gusdorf, 1980, p. 38). In the immediate moment of an experience, the agitation of things ordinarily surrounds me too much for me to be able to see it in its entirety. Memory gives me a certain perspective and allows me to consider the meaning of lived events and their particular context in time and space. As an aerial view sometimes reveals

roads and paths invisible to someone on the ground, so the remembering of my past reveals the major lines that I may have failed to notice, the demands of the deepest values that I hold, the contours of the decisions that have brought me to where I am.

Autobiography is not simply the writing out, from memory, of the details of one's past. It is not an act of mere repetition. At best, the autobiographer draws out little more than ghostly images of the colors and details of that time which is forever gone. Even more, this image will be distorted by the fact that the autobiographer has not, for a long time, been the same person who actually lived those recalled events. A new mode of being takes shape in the act of memory. The truth of the self begins to be revealed—that is, if what Hegel said is true, that "consciousness of self is the birthplace of truth" (Gusdorf, 1980, p. 38). The past that I recall in autobiography has lost its flesh-and-bone structure, but it has won a new and more intimate relationship to my life. Now, after being long dispersed throughout the course of my lived time, my "bios," I can discover myself and draw myself together in the present time (Gusdorf, 1980).

The Ordered Self

While autobiography serves the task of human thinking by helping to remember, it does more. Through autobiography, humans can build and order their present by way of the remembered past. This is what the ancient Greek philosopher, Heraclitus, meant when he said that autobiography is, at its very essence, a cosmology, i.e., an act of bringing order to the universe.

Human experience cries out for understanding and interpretation. In attempting to look back and to interpret the events from our personal history, we try to construct order and meaning. The focused unification provided by remembering is requisite to sense and order. Through it, human life is given shape that extends back into the past and forward into the future. Often, this is a shortened, simplified tale, where completeness in the story may be sacrificed for moral and aesthetic purposes. When this happens, history provokes art, myth, and ritual, as in the story of the rabbis. Perhaps this is why Mnemosyne, the goddess of memory, is the mother of the muses. Without memory, we lose our history and place. Without telling our story, past remains past, remains sequence, and can never be brought into simultaneity with our present time.

The order that humans seek is never static and 'out there' but always going on within us and coming into being. To use another Heraclitian metaphor, a person cannot step twice into the same stream. The human self is always in a state of flux and is impossible to capture once and for all. But, as Olney (1972) has suggested, there is an essential oneness to the self, an integrity and internal harmony that holds together the multiplicity and continual transformations of being. In every individual, to the degree that he is individual, the whole principle and essence of order is present, so that in his integrity the whole harmony of the universe is entirely and, as it were, uniquely existent.

In her magnificent autobiography which she entitled *The Measure of My Days*, the novelist and short story writer, Florida Scott-Maxwell, speaks of her great struggle to achieve order from the chaos of modern living. In fact, she took up her 'notebook,' that is the writing of her autobiography, precisely to face this dragon and wrestle it into some sort of appeasement. "What frightens me," says Scott-Maxwell, "is modern man's preference for the arid. He claims to understand, yet knows himself so little he dares dispel mystery, deny the depths of the human psyche, and prefers to bypass the soul. It is inevitable that he arrives in a desert without values" (Scott-Maxwell, 1979, p. 112).

As a student of Carl Jung, Florida Scott-Maxwell saw the need to explore her own psyche in order to make sense of her life. At one point in her autobiography, she speaks of modern life being the precise reverse of psychoanalysis. "Instead of gathering oneself together, it is a dispersal of oneself" (Scott-Maxwell, 1979, p. 56). And then, in a passionate phrase that summarizes the zest and intensity that remained in this 85-year-old woman when she wrote her last book, the autobiographer says, "you need only claim the events of your life to make yourself yours. When you truly possess all you have been and done, which may take some time, you are fierce with reality" (Scott-Maxwell, 1979, p. 42).

Autobiography assumes the task of reconstructing the unity of a life across time. This lived unity of thought, and feeling, and action is not received from the outside. It is certainly true that events influence us. Sometimes, they determine us and almost always limit us. But the essential themes, the structural designs that impose themselves on the complex array of exterior facts, are the constituent elements of the human person. Modern psychology has taught us that human beings, far from being subject to ready-made, completed situations given from the outside, are the essential agent in bringing about the situations in which they find themselves placed. It is human intervention that structures the terrain where life is lived. We hold the brush that forms the colors and shapes, so that the landscape is truly, in Amiel's phrase, "a state of the soul."

Autobiography is an important means to self-knowledge because it enables the person to recompose and interpret his or her life into a kind of wholeness. An examination of my thoughts and feelings which is limited to the present moment will give me only a fragmentary cutting from my personal being. In recounting my history, the measure of my days, I take a longer path, and this path that goes round my life leads me more surely to myself. The recapitulation of ages of existence, of landscapes and encounters, obliges me to situate who I am in perspective to who I have been. My individual unity, the mysterious essence of my being, is that which is achieved (Gusdorf, 1980).

"Man tries to make for himself in the fashion that suits him best," writes one of the greatest cosmographers of the twentieth century, Albert Einstein. And he continues: "A simplified and intelligible picture of the world; he then tries to some extent to substitute this cosmos of his for the world of experience, and thus to overcome it. This is what the painter, the poet, the speculative philosopher, and the natural scientist do, each in his own fashion. Each makes this cosmos and its construction the pivot of his emotional life, in order to find in this way the peace and security which he cannot find in the narrow whirlpool of personal experience" (Einstein, 1962, p. 225).

And it must be, from the nature of this picture, that the construct we develop will appeal not only to our intellect, but to our emotions and our whole self. Does it satisfy my feeling and my need for order? This seems to be the final question we can and must ask, not only from the painting or the poem, but also from the theological doctrine, or philosophy, or psychological theory. As Ernst Cassirer says in his "Essay on Man," "in language, in religion, in art, in science, man can do no more than to build up his own universe—a symbolic universe that enables him to understand and interpret, to articulate and organize, to synthesize and universalize his human experience" (Cassirer, 1944, p. 221).

In "Four Quartets," what many believe to be T. S. Eliot's supreme autobiographical statement, the poet summarizes this need for recapitulation and discovery and the creation of a personal cosmology in his own unique voice:

> What we call the beginning is often the end
> And to make an end is to make a beginning.
> The end is where we start from ...
> A people without history
> Is not redeemed from time, for history is a pattern
> Of timeless moments ...
> We shall not cease from exploration
> And the end of all our exploring
> Will be to arrive where we started
> And know the place for the first time.
>
> (Eliot, 1970, pp. 207-208)

The Imagined Self

I have spoken thus far of the power of memory to trace, with its spindling thread, the shape or form of a human life, the journey of the "bios." And in the tracing, in the recalling of one's own story, a cosmology takes place, one which can enable integration and the development of a sense of wholeness. The great Irish poet, William Butler Yeats, in fact did this through his poems, and plays, and letters, and finally in three books which constitute his autobiography. In a letter to his father, Yeats said, "one goes from year to year gradually getting the disorder of one's mind in order and this is the real impulse to create. Till one has expressed a thing it is like an untidy, unswept, undusted corner of a room" (Wade, 1955, p. 627).

The impulse to create. And in the autobiographical act, what one creates is the self.

The neo-Platonist Roman philosopher, Plotinus, theorized that every person has two souls, a lower and a higher, and that each of these possessed a unique form of memory. He argued that a lower soul recalls the details of one's life, one's relationships and events, those things that "we retain with emotion." But a higher soul "must desire to come to a happy forgetfulness of all that has reached it through the lower ... In this sense we may truly say that the good soul is forgetful. It flees multiplicity; it seeks to escape the unbounded by drawing all to unity, for only thus is it free from entanglement" (Enneads, Tracts 31-32).

If Plotinus was right, then W. B. Yeats was a good soul indeed, for he was capable of forgetting most of the things that the lower man "retains with emotion," as well as myriad facts that even a lower man could scarcely get emotional about. Yeats had a miserably bad memory for names, dates, specific events, and facts, which might lead many to conclude that he was poorly qualified to be an autobiographer. After all, isn't an autobiographer not utterly dependent on memory for both the shape and details of the recitation? Perhaps not.

"Faces and names are vague to me," Yeats admits in "The Trembling of the Veil," the second volume of his autobiography. (Yeats, 1953, p. 153). But there is no sense of regret on Yeats' part, nor concern for his ability as an autobiographer. What he is interested in is coupling a weak factual memory with a strong creative forgetfulness. While he was forgetting names

and faces, his creative spirit was busy recalling the ideas and truths lying behind those names and faces. What he could not, or chose not to remember, he invented. And his inventions reflected the deeper realities, his perceived archetypes, of those whom he loved and with whom he worked. Yeats himself called this the memory for eternal things (Olney, 1980).

It is not proper, nor may it be constructive, to maintain a view of autobiography as an objective accounting. Every autobiography is a work of art, and at the same time, a work of enlightenment. It does not show us the person from outside in his visible actions, but the person in his inner privacy; not as he was, not as he is, but as he believes and wishes himself to be and have been.

According to Gusdorf (1980) and other theorists, what is in question with autobiography is a revaluation of individual destiny. It is the act of a creator to construct and give meaning to experience, one's own mythic tale. The author, who is at the same time the hero of the tale, wants to elucidate the past in order to draw out the structure of his being in time. Thus, the author exercises imagination, creating images and metaphors in the development of the narrative, and in so doing, "adds himself to himself" (Gusdorf, 1980, p. 45). Through imagination, the autobiographer creates the past by inspiring facts and events with interpretation, direction, suggestiveness, and ultimately, human meaning. So, like our story of the rabbis, the present is rooted in the past. But the obverse is also true.

The past is recreated and springs to life in the telling of the story in the present. Imagination is as much an essential ingredient in autobiography as is memory. Some, like Yeats, would argue that imagination is more essential. Another poet, for a short while a contemporary of Yeats (although they lived 3,000 miles apart and never met each other), praises the power of the mind (and the soul) to invent:

> To make a prairie it takes a clover and one bee,
> One clover, and a bee,
> And revery.
> The revery alone will do,
> If bees are few.
> (Emily Dickinson, Poem No. 1755)

In his autobiography entitled *Report to Greco*, the celebrated Greek novelist Nikos Kazantzakis employs an ample portion of revery. In fact, somewhat like Plotinus, he claims there are two types of truths for him—the truth of historical fact and the truth of imagination. He discovered the latter in writing his autogiography, and this discovery brought him great joy and lightened his burden. "The truth which had been storing up anguish in my breast for such a long time was the the real truth; the real truth was this newborn creature of imagination. By means of imagination I had oblitereated reality, and I felt relieved" (Kazantzakis, 1961, p. 137).

And so from all this we can say that the act of autobiography is essentially an act of metaphor. In a recent article in *Harper's*, Cynthis Ozick speaks of metaphor as that which relies upon experience, that which transforms the strange into the familiar. Homer's "wine dark sea" for example—if you know wine, you will know the sea. "Metaphor uses what we already possess and reduces strangeness ... Metaphor belongs to clarification and humane conduct" (Ozick, 1986, p. 68). So more than saying what the world is, or is like, the metaphors of self that are autobiography tell me who I am, and am like. And perhaps more—who I am becoming. And in the end, it connects me more nearly with the deep reaches of myself and with the world of my experience.

Autobiographical Acts and Education

The self, St. Augustine said in his *Confessions*, is a field in which people labor with much sweat and little knowledge. What Augustine attempted to do in his *Confessions*, which most critics consider to be the first important autobiography in Western civilization, was to discover the truth about himself (St. Augustine, 1969). In this search for self-knowledge, Augustine's *Confessions* illuminate the relationship between truth, time and the self (Lloyd, 1986).

It is my view that autobiography has an important role to play in modern education. If education is essentially the seeking after knowledge and the pursuit of truth, can we, without terrible risk, sidestep self-knowledge as we make our way and lead others along the way on this noble journey? One might argue that there can be no abstract knowing without personal knowing; that our own expression of the world "out there" is inevitably determined by our view of ourselves. Since we put various pieces of information together and order our experience according to our own deeply felt needs and desires, our knowledge of the world cannot be separated from self-knowledge (Porter and Wolf, 1973).

It is also important to note that the intellect is not a separate faculty. It is an activity of the whole human organism, an activity which begins in the senses with direct experiences of the world. It is an experience that involves the emotions. I hope educators have long dispelled the notion that learning and human development are disconnected, and that knowledge and those who are seeking it are essentially unrelated. But sometimes, as I survey the teaching and learning processes operating in my own area of education, i.e., the university, I have my sincere doubts.

In my experience as both a learner and a teacher, I have known the benefits of thinking autobiographically and of employing autobiography, defined broadly, in formal education. There are numerous possibilities for engaging oneself and others in autobiographical acts without taking on a full recounting of one's life. Journal writing, life reviews of selected events, oral histories, and various artistic endeavors can be employed in education to help people think about their identity, about their relationship with the world, and about the act of thinking itself. For the remainder of this paper, I shall explore the use of one of these techniques, that of journal writing.

I am now in my eighteenth year as a journal writer. I began in college, at the suggestion of a professor who himself was a 'journalist,' and have kept up the activity, increasing my fervor about it as the years have progressed. I have known the trace of the thread around the edges of memory, as well as Ovid's suggestion that "it is a pleasure, too, to remember." I have known how the pen has helped to turn chaos into some semblance of structure. And then upon further thought, and facing that which somehow remained an abyss, the slow blending into order. And revery, Emily Dickinson's lovely revery—that, too have I known. I dread who I might have become without this revery, those many pens, those acts of implosion into myself.

In a thoughtful article about the use of journals in education, Abell (1986) suggests there are four outcomes students often experience by way of engaging in such autobiographical acts: (1) it provides a connection between what students know from their own life experiences and the ideas that are presented in class; (2) it encourages students to 'gain a voice' of their own; (3) it provides a personal context for learning; and, (4) it allows students to evaluate changes in their own thinking over time.

As a teacher who often encourages the keeping of a journal as part of formal course requirements or as elective projects, I can affirm this list of outcomes as real and achievable on the part of many college students. But as this paper has argued, the issue at stake is more than the establishment of context or the tracing of progress. The issue at stake is thinking and identity.

If we do not know the self, what can we know? If we cannot think upon our own lived experiences, about what can we think? An act of autobiography is among the most natural acts we perform as human beings. It is an act which recalls the self, and makes an accounting of it, and trusts it enough to respect it as both the subject and object of our thought and discourse. Do such acts not belong in the very center of our attempt to help others and ourselves think, and learn, and develop as human beings?

And when the calamities of modern life approach us, the inevitable alienation and distress, the savage competitiveness and fierce materialism, the threat of personal and global annihilation, what shall be our recourse? What shall save us? What, if not the telling of our own story, will prove to be sufficient?

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Part II:
Philosophical Aspects

THE PERSON, THE POLITICS OF THINKING, AND THE FUTURE OF HUMANKIND

Willard D. Callender, Jr.

During the 1986-87 academic year, Will Callender wrote a book entitled *The Adult Education Class* while on sabbatical leave as a Visiting Scholar at Harvard University's Philosophy of Education Research Center, a component of the Graduate School of Education. The book, written in dialogue form, purports to be a philosophy of education for adults, as if adults and their education count, as if it is their responsibility rather than the task of children to confront and seek solutions to the problems of the world, as if thinking and discussing ideas is more important that fighting over them. In Will's view, thinking and self-educaiton, citizenship and democracy, are finally inseparable, the first two furnishing the necessary conditions for the second pair.

Will plays himself in the eleven-person cast of the *Adult Education Class.* As its author, he is undoubtedly to be found as well in all ten of the other characters as they collectively search for a substantial, universal meaning of adult education. Here, we print a snatch of correspondence between Will and Emerson Hall, a fictitious graduate student from Harvard, who as a student intern is the tenth student member of the class. The correspondence conveys a position about education, the educational politics of thinking, and the stakes involved for the future of humankind.

February 14, 1987

Dear Will:

You asked in your recent letter for a summary of my interests as they might pertain to the course I will be auditing with you, which I believe you call "Introduction to Adult Education." Also, you wanted me to say a little bit about the internship, what I am interested in and what I aspire to do. I have appended an overly long statement for the former purpose, which you can share with the class. It will at least acquaint them with my work. I hope they won't think me too opinionated. I have taken the habit, since I saw you last, of at least stating what I really think—and pleasing myself with a certain flourish, E's own style if you will—and trying to get beyond this overrated, misunderstood virtue of objectivity. Underneath it all, I am of course the same uncertain, confused student—now pilgrim—that I always was. By the way, don't you think pilgrim a better word than student for someone over thirty? I mean for people like you and I?

As to the internship, I can't get to Gorham until the first of March or so, nor can I even then attend all the classes. I do request that you mail all course materials to me. I promise on my part to read everything and even send occasional comments on my reactions, which you certainly have my permission to distribute to the whole class, if that would be useful. When I am able to attend, I will be glad to lead a discussion, if that is requested, do gopher work for the class, or help evaluate class accomplishments. Did I tell you that I am taking a course down here in organizational intervention? Evaluation science is part of the work and I would welcome some experience in evaluation, if that can be worked in.

All of this is a little tenuous I know. My major commitment, to be clear, is to complete a synoptic paper on the subject described in the attached abstract. I really want to work with you because my sixth sense tells me that you can be a big help to me on it.

Best personal regards and Happy Valentines Day,

Yours truly,

Emerson Hall
209 Ramshead Road
Medford, Massachusetts

The Death of Education and the Rebirth of the Thinker

by
Emerson Hall, Jr.
February 14, 1987

Death

As far as I can see, education is now dead. Was it homicide or suicide? I don't know; let the coroner decide. It was murder nonetheless and the murderers are legion. And it all happened ever so slowly and in full public view. Of course, educational 'problems' and 'issues' have always existed; real education is difficult under the best of circumstances. So we are quite familiar with problems of access and opportunity, poor teaching, the failure of children to acquire the arts of reading and writing, high absentee and dropout rates, substance abuse, underfunding, low SAT scores, and home/school squabbles, particularly around the so called "morality questions." I wouldn't minimize these concerns in the least; that's part of what I am talking about as well. Yet, the very idea that these problems are being addressed and solved—the idea that a significant reform is going on—is the biggest farce of all. What's the illusion? It is that the improved generic "educator" standing in front of us, after particular reforms, is a real educator. What I see instead is something like the portrait of the zombie in a horror movie; he looks just like us but his soul has been stolen and his body occupied by an alien from another planet. Yet, considerable interaction and observation is required to discover the alien. By then, it is too late.

One reason this zombie analogy works is that the murderers of education are so well-meaning and friendly; they are seemingly benign. The death is like that type of euthanasia in which a concerned family member shortens the inevitable suffering of a loved one. The elder wants to save the young from going through all that! All that? Save them from what? Thinking, that's what, the little project of thinking for oneself. At the very least I can identify some of the really big killers in the cast of plotters. Let's start with Brutus.

1. The Quantity of Available Knowledge

I have a friend, a historian, who is fond of saying that when it comes to ideas about man there are no new ones since Francis Bacon. Eh gads, Bacon died in 1626. She thought every idea since was some straightforward combination of foundation ideas available by the time of his death. If she is right, it might comfort some. As for me, I am overwhelmed whenever I walk through these incredible libraries here at Harvard and through the Coop and the other

bookstores in Harvard Square. I can feel the weight of knowledge laying on top of me. My intuitive bias is toward Toffler-like propositions, or perhaps ones from Kenneth Boulding. For example, I find myself saying that more knowledge must have been made available in the last five years than in all previous history. And I am talking about books. It is the age of the computer, right! The knowledge that really disturbs me is the fact there are more good books available **directly** on any topic I am studying than I could in fact read or use. Who minds large libraries if a good literature search actually identifies a definitive, comprehensible body of literature. That libraries contain more information than I can use is actually a comforting thought; the corollary being that people of other talents and interests are likewise finding what they need. But soon, the idea of a quality literature search will be superceded on objective grounds, there being too much good, directly relevant, thought available to the solitary human searcher. And who is to say that my friend's argument won't soon be true, if it isn't already. Perhaps all she need do is use the ploy of predecessors whose prophecies have failed: change the reference from Bacon to Sarte, or to Michael Foucault. My arguments, I sadly suspect, have already been made better than I could make them, and worse, by someone I may never even get to read.

What I am getting at here is what you, Will, used to call—following Simmel and Cassirer—the "tragedy of culture," the paradox that man is essentially an inventor of culture, but that this, his greatest power, burdens and weakens him, the sheer increase in its quantity coming to exceed ever more certainly the capacity of the newly born to learn, comprehend, and use it. It will be easier for them to stop trying and have fun instead, off on a Florida beach or in some bar watching the super bowl, smug with the knowledge that they are products of a great civilization which produced great thinkers.

2. The Ignorant Expert

And now for Cassius. As you well know, we have dealt with the problem of the quantity of knowledge by increasing the division of labor and by coronating specialist, professional classes as the official knowers of sectors of knowledge and practice. Four things strike me as important about these elite classes. First, that they really do know enormous amounts, more than any generalist or common citizen could know about their subject. Second, that their knowledge replaces the obligation of the citizen to know what they know. Yet, they hold the power over the curriculum that young and new students must study. Typically this curriculum is a 'show' or 'shadow' curriculum; insubstantial, arcane, and void of humanness in its own right, this curriculum consists of gymnastic test items whose passage qualifies the student for **later** entrance into the real curriculum when admitted to professional studies. Third, professional specialists are usually both enemies of general human knowledge and ignorant themselves of what human knowing can mean. Finally, the above described situation is getting worse every day. Indeed, the fantastic specialization going on inside the professional and scientific communities is so extensive as to prevent the generalist professional from mastering his profession, the sub-specialties becoming arcane communities in their own right. In the old humanities of philosophy, mathematics, and literature, as well as in the disciplines founded in the nineteenth century, an incredible ossification begins to set in. People start writing for a presumed audience of other specialists **within the main profession;** there is hardly even the pretense that knowledge is for the public anymore. Suddenly, there is more written on Melville, Joyce, or the James brothers than scholars can profitably read, yet the attempt to do so outcompetes efforts to acquaint the public directly with the thinker's actual work and thought.

Most of what I am concerned about is evident in this plain talk from the writings of Ortega Y Gasset, as respresented by Mortimer Adler in his book "A Guidebook to Learning."

> "[The scientist who] is only acquainted with one science, and even of that one only knows the small corner in which he is an active investigator. ..even proclaims it as a virtue that he takes no cognisance of what lies outside the narrow territory specially cultivated by himself, and gives the name of "dilettantism" to any curiousity for the general scheme of knowledge.
>
> Anyone who wishes can observe the stupidity of thought, judgment, and action shown today in politics, art, religion, and the general problems of life and the world by the "men of science," and, of course, behind them, the doctors, engineers, financiers, teachers, and so on.
>
> Compared with the medieval university, the contemporary university has developed the mere seed of professional instruction into an enormous activity; it has added the function of research; and it has abandoned almost entirely the teaching or transmission of culture.
>
> [The citizen] is the new barbarian .... This new barbarian is above all the professional man, more learned than ever before, but at the same time more uncultured—the engineer, the physician, the lawyer, the scientist" (Adler, 1986: 159).

3. The destruction of the learner as thinker

Certain facts about knowing and learning are obviously true of human beings, requiring no proof beyond mere introspection: a person must focus on some point, one thing at a time in order to learn anything at all; knowledge, skill, and discipline is built up in sequence, this fact on that fact, this question from that understanding, this skill on that skill; knowing something requires an exercise of judgment; learning is an active process which engages all of the abilities of the learner; and all learning becomes a unity of knowledge for the individual knower. Yet, these are not the principles on which curriculum is organized. Subjects, as inert, certain bodies of knowledge, are taught in quanta and for their own sakes. After learning to read and write, other sequentia of subject matter are treated as unimportant; students are asked to learn only what the older generation wants taught, even if they themselves don't know what that is; and beyond that, the quality of the person as learner, thinker, and citizen are increasingly treated as unimportant.

It is evident what a slow tortuous death the individual thinker has suffered in the clarity with which Alfred North Whitehead put the case in 1929.

> Culture is activity of thought, and receptiveness of beauty and humane feeling (Whitehead, *The Aims of Education,* p. 13).
>
> In training a child to activity of thought, above all things we must beware of what I will call "inert ideas,"..., ideas that are merely received into the mind without being utilized, or tested, or thrown into fresh combinations *(Ibid).*
>
> The mind is never passive; it is a perpetual activity, delicate, receptive, responsive to stimulus. You cannot postpone its life until you have sharpened it. Whatever interest attaches to your subject-matter must be evoked here and now; whatever powers you are strengthening in the pupil must be exercised here and now; whatever possibilities of mental life your teaching should impart, must be exhibited in the here and now. That is the golden rule of education and a very difficult rule to follow (*Ibid,* p. 18).

> The solution which I am urging, is to eradicate the fatal disconnection of subjects which kills the vitality of our modern curriculum. There is only one subject-matter for education, and that is Life in all its manifestations. Instead of this single unity, we offer children—Algebra, from which nothing follows; Geometry from which nothing follows; History, from which nothing follows; a Couple of Languages, never mastered; and lastly, most dreary of all, Literature, represented by plays of Shakespeare, with philological notes and short analyses of plot and character to be in substance committed to memory. Can such a list be said to represent Life, as it is known in the midst of living it? The best that can be said of it is, that it is a rapid table of contents which a deity might run over in his mind while he was thinking of creating a world, and had not yet determined how to put it together (*Ibid*).
>
> ...the understanding that we want is an understanding of an insistent present. The only use of a knowledge of the past is to equip us for the present. No more deadly harm can be done to young minds than by depreciation of the present. The present contains all that there is. It is holy ground; for it is the past, and it is the future (*Ibid*, p. 14).

The most shocking of these Whitehead quotes, I find, is the one on the curriculum, since many of we lovers of the liberal arts are trying to bet back to Shakespeare and two languages, science, and literature. And who could ask for a more wonderful ambition than for children to feel themselves, like God, prepared to author a world, their world. He reminds us that when we succeed in restoring some coordinated curriculum, we have not succeeded in restoring the person—the individual, passionate thinker—to the center of learning; our work would have just begun. But for my money, curriculum reconstruction is a good place to begin. As Mortimer Adler points out, university curriculum are held together mostly by the alphabet. Courses are chosen as much on the advice of a catalog index as a human counselor. Programs of study and individual courses are taken by recourse to an alphabetically arranged listing, not by a concept of curriculum. What the student gets is overwhelmingly vocational training, not education.

Rebirth

Will, I can almost hear you saying; "So that's what's bothering you Bunky!" or "If that was the answer, what was the question?" It is only fair to inform you that it is not wisdom like that which has led me to seek to undertake this internship with your program. Rather it is the remembrance, now a glimmer, of a course I once took with you on "The Social Psychology of George Herbert Mead." Do you remember? The glimmer is not the course itself—I remember it quite well and continue to benefit from it to this very day—but rather of your interest, which seemed quaint at the time, of trying to expand the freedom of the individual within Mead's understanding of the self. I found it quaint because Mead was such an obvious friend of freedom, and individualism, and community, and democracy, and of course thinking. Don't you remember, mind is "symbolic communication," mind is "thinking." It struck me at the time as being as absurd as criticizing Christ for not being sufficiently Christlike, a criticism which surely should be reserved for the churches.

But now I think I understand you better, or if I don't, I am still intrigued. I read you as wanting to free the thinker in all of us at the earliest possible age, not at the expense of society but as the necessary ground for humane society. Yes, I admit it, I find myself moving in a serious way to Rousseau, and Carlyle, and yes, even to my namesake Emerson. In fact, I am thinking of entitling my thesis. "Freeing the Person: The Unfinished Work of the Enlightenment."

It intrigues me to think that you are now teaching something called adult education. I can't imagine you doing that without some attention to the issues I have just raised. That is at least my major supposition in joining the class. I hope I have said enough here to introduce its members to my interests and orientation. I will see you on March first.

Signed,

Emerson Hall

February 18, 1987

Emerson Hall
209 Ramshead Road
Medford, Massachusetts

Dear Emerson:
Thanks for the recent letter regarding your internship plan. Your paper will serve nicely as a communication to the class. In fact, I passed it out already, yesterday. We accept your offer to act as course evaluator, and I personally would welcome any feedback you might care to give me, on teaching style and class organization as well as content. Frankly, I have had a lot of trouble teaching this course over the years, this being the fifth time out of the stall. In fact, the book I am writing is in fair part a chronicle of an educational nightmare.

You will find out soon enough how the course relates to your interests, so there is no need to answer all of your questions now. One word of explanation might be in order though. The course is an effort to find out what went wrong with 'adult education,' which one author recently called "The Sleeping Giant of North American Education." I don't know about that; I call it the Rodney Dangerfield of world education. I fancy myself a rotund Charles Atlas, who goes around madly saying "It doesn't have to be like that." My intent is to develop, or more correctly reinvent, a universal philosophy of adult education, one that applies to all adults and where education counts. We need adults who are willing to change themselves and take on the burden of preventing nuclear war. Instead we have mostly folks who celebrate themselves as being educated men and women, at age twenty-five more or less. Most adults have stopped, huddled around the T.V. set or some barbecue, waiting around for a new generation of children who will value peace. The poor children! And, if you haven't noticed, adults now for the most part dislike children—for some they are a responsibility, for others an inconvenience, or a burden, then a pain, or a hateful reminder, and in the worst case, moral agents—little punishers— who must be punished first. Life increasingly becomes a war between the sexes and a war between the generations. And at the center of this mess are adults who claim to be educated because they have a B.A. and claim to be learning because they go to fitness workshops. At the same time, as you declare, the thinker in them is dead.

Bring back Socrates, an educator who knew he couldn't teach anyone anything. Instruction is for sophists. By the way, didn't your namesake R.W. say something like that, to the effect that he could provide 'provocation' for us but not 'instruction.' He was a wise man, in fact he was "Man thinking."

That gets me to another reason for welcoming your letter. I have been invited to present a paper as part of a Symposium in March on the theme: "What Socrates Began: An Examination of the Intellect." I chose for my talk the embarassingly pretentious title: "The Person, The Politics of Thinking, and the Future of Humankind." In December I actually wrote a

terribly pedantic, boring, thirty page paper on that topic. When I got your letter, I saw immediately that my paper didn't have to be this way. You were addressing the same topic straight on, covering much that I was trying to say. I think I can say the rest by writing it to you. So, surprise, please find enclosed a short paper responding to yours. With you as my teacher and I as yours, we might help each other improve our thinking on thinking, and on other topics as well. Such a conversation is one view of human progress and personal transformation. Is there really a better way?

I look forward to seeing you in March. I think the members of the class are looking forward to meeting you as well. At least, they are curious after reading your first paragraph. Wow.

Best personal regards and say hello to your sister.

Yours truly,

Willard D. Callender, Jr.
203 Margaret Street
South Portland, Maine 04106

Wc/w
Enclosure: Thinking about the Thinker

Thinking about the Thinker
and the Rebirth of Education

Don't expect me to be as organized, clear, and linear as you were in your bold little paper. Let me just say that I agree with you in general and that your raging words have lit a fire in me. Why shouldn't I give myself permission to be just as outrageous. We go through life knowing that what organizations say about themselves is mostly untrue. Who is going to say so if we don't. Yes, you're some pilgrim alright.

Anyway, apropos of your argument, I just want to give you a couple of things to think about on Descartes, and from your namesake Ralph Waldo Emerson. Also, I thought I would try to formulate some advice to teachers on the assumption that you, Whitehead, and Emerson are right. Be sure to tell me if I am way off base.

On Rene Descartes

I know you have read Descartes' "Discourse on Method" and his "Meditations," but I urge you to do it again, after meditating on what you have written to me. I mean here we have this brilliant, well-travelled, best educated, responsible man, sitting alone by that fire, seriously entertaining the almost mad prospect that everything he previously believed to be true might be false. This project of radical doubt should be tried by every person, because it has been, in its effects, module 1 of the modern adult education class for all of us ever since, whether we know it or not. And, he proves, with the help of a little devil and a dream, along with the well known illusions of sense experience, that one can rationally doubt the whole world away. If we each had the guts to follow his travelogue, his triptik, we would inexorably be forced by his method to doubt the whole world away. What provocation!

And, E., look, look where he ends up at the end of his journey, before he rediscovers God and reinvents the world. He ends up with "The Thinker." In fact, in the "Second Meditation" he drops the "therefore" in the cogito, "I think, therefore I am." It becomes: "I think, I am." In other words, thinking and being are identical at that point.

But I rush ahead of myself. Descartes, in successfully doubting away everything can't escape the "I who doubts," because doubting is a thought. I can say: "I doubt away the physical universe, including my own body, it might be a dream"; "I doubt away all of my sense experiences; they might be illusions"; "I doubt away my imaginations; what the hell is imagination anyhow"; "I doubt away mathematics ; I doubt away other people" and, "I doubt away God." Grant me all that and I still must recognize that still small voice of the "I" that doubts. Doubt thoughts are "I" thoughts, it is inescapable. "I doubt, doubt is a thought, therefore I think, therefore I exist."

So here we have proof that the "thinker" exists, and that man is a thinker before becoming anything else. Also, we have proof that man is always a thinker, and that everything he is is never more than a thought, even when it is built into steel and concrete.

But what a lost thinker! He can be sure he thinks, and therefore exists; he can be sure that his thinking occurs in and through certain pure mental functions; sensing, imagining, asserting, comparing, judging, and concluding for examples. But none of the content of thought is necessarily true; he just doubted it all away! There is a knower whose lifetime knowledge is now totally chaotic; void; unbelievable. A thinker returned to the beginning of time, to the big bang, to genesis, to total amazement and, if he is lucky, wonder. What a funhouse!

Isn't that the beginning of education? Isn't that where education should start? Isn't that where education always remains, after we have come to know everything we know?

On Ralph Waldo Emerson

E., I can see from your letter that you have read your namesake, Ralph Waldo Emerson. Also, I see that you understand his potential importance to your case. But, in the event that you haven't had the time to dig into all of his essays or into the journals, let me offer a few tips for guidance. If I am not wrong, Emerson picks up and takes on Descartes' burden, and with a lot of Kant and some Hume, picks up the issue of the thinker, and does so in American terms. And it is you he sought to encourage—read the Transcendentalist—he was not trying to make the world safe for John Wayne. My personal favorites are "The Divinity School Address," and the essays "Circles," "Nature," "Politics," "The Poet," and "Self-Reliance." "To essay is to be." Do you get that little word pun: to say, esse, address, preach, say, be?

But the essay I recommend for your project is "The American Scholar." I am told that each essay is a word cathedral, in which every sentence is a provocation which can evoke the whole, a finite journey into the infinite, if one but knows where to begin and stop, if one knows oneself, if one—that is—knows how to be a self. With those enscription rules, I offer these quotes from the American Scholar.

> It is one of those fables, which, out of an unknown antiquity, convey an unlooked-for wisdom, that the gods, in the beginning, divided Man into men, that he might be more helpful to himself; just as the hand was divided into fingers, the better to answer its end.
>
> The old fable covers a doctrine ever new and sublime; that there is One Man,—present to all particular men only partially, or through one faculty; and that you must take the whole society to find the whole man" (Emerson, 1983, pp. 54-55).

And the last sentence in the same paragraph quoted above:

> The state of society is one in which the members have suffered amputation from the trunk, and strut about so many walking monsters,—a good finger, a neck, a stomach, an elbow, but never a man (Ibid).

And, on the scholar, with some apparent regret,

> In this distribution of functions, the scholar is the delegated intellect. In the right state, he is, **Man Thinking**. In the degenerate state, when the victim of society, he tends to become a mere thinker, or still worse, the parrot of other men's thinking *(Ibid)*.

Emerson, isn't that something, he is talking about homicide too, just as you have done. Isn't degeneration something like the killing of genesis, not exactly a matricide, but more of a slow, silent suicide.

And on degeneration,

> The theory of books is noble. The scholar of the first age received into him a world around; brooded thereon; gave it new arrangement of his own mind, and uttered it again. It came into him, life; it went out from him, truth; It came to him, short-lived actions; it went out from him, immortal thoughts. It came to him business; it went from him, poetry. It was dead fact; now it is quick thought. It can stand, and it can go. It now endures, it now flies, it now inspires. Precisely in proportion to the depth of mind from which it issued, so high does it soar, so long does it sing.

But,

> Yet hence arises a grave mischief. The sacredness which attaches to the act of creation—the act of thought—is transferred to the record. The poet chanting, was felt to be a divine man: henceforth the chant is divine also. The writer was a just and wise spirit: henceforth it is settled, the book is perfect; as love of the hero corrupts into worship of his statue. Instantly, the book becomes noxious: the guide is tyrant. The sluggish and perverted mind of the multitude, slow to open to the incursions of Reason, having once so opened, having once received the book, stands upon it, and makes an outcry, if it is disparaged. Colleges are built on it. Books are written on it by thinkers, not by Man Thinking; by men of talent, that is, who start out wrong, who set out from accepted dogmas, not from their own sight of principles (Emerson, 1983, p. 57).

again,

> Hence, instead of 'Man Thinking,' we have the bookworm (*Ibid*).

And he was saying all of this in 1837 before the worship of science replaced science, and the worship of television replaced the book. Now, we are in danger or trying to worship critical thinking, which isn't Man Thinking either. Don't you see a similiar point to Cassirer's "Tragedy of Culture." By the way, those are R.W.'s capitals on Man Thinking, just in case you thought them mine. He clearly didn't want us to miss the point.

What is a Teacher to do?

E., between the two of us we've described some kind of a bloody scene. Could it be we've bloodied our own hands in the act of describing the murderers? Are we just reporters? Are

we among the victims? I don't know the answers. I do admit some sense of stepping back, tidying up, and sheathing the knife when getting to the question of 'advice for teachers.' Being one, I find myself giving advice within the familiar, grooved forms available in the teaching profession; you know, a short, objective, upbeat, undisturbing, reform list—a list of 'recommendations.' Something is lost. At any rate, here is the advice I thought I might give at that symposium on the intellect, in so many words, without boring you with numbers and letters.

I certainly want to remind teachers of the truth of Descartes and Emerson, that man is a thinker, that "Man Thinking" is her essence. When we aren't being mere animals, which is a lot of fun and real important too, we are thinking. Everything we are conscious of is a 'thought' and 'thoughts' are, unsurprisingly enough, the product of thinking.

Then, I would want teachers to understand what kinds of mentation go under this heading of thinking. Specifically, I would ask them to see that thinking includes imagination, feeling, motivation, sentiment, emotion, rumination, fantasy, dreaming, remembering, reasoning, intending, projecting, constructing, and producing. Thinking, in other words, is any form of symbolic association which is going on consciously, or even semi-consciously, when we do anything else. Thinking is the mental thing we do when we do everything. As Heidegger and Wittgenstein have shown, among others, thinking is mysterious—you can't quite name it or catch up with it—on the other hand it is amazingly ordinary; it is done all the time and we can scarcely help ourselves from it, we can't prevent it.

This tells us that thinking is not synonymous with what is called rational thought, it can not be equated with reason, science, logic, syllogisms, the dialectic, mathematical reasoning, critical thinking, or the consciousness of consciousness. As vitally important as reason is, it is a sub-type of thinking, and the weight given to it is necessarily a political consideration, a normative judgment. I will say more about that in a moment. For now, I simply wish to establish that the statements: "I am tired," "angry," "eager," "enthusiastic," "sketching," "anticipating next weekend," "remembering my grandmother," or "considering a new job" are no less thoughts of a thinker than are the thoughts "two plus two equals four" or the thought sequence "it is five minutes to the nearest store," "Johnny just left for the nearest store; therefore, "It will take Johnny at least five minutes to reach the nearest store."

After establishing that rational thought is a sub-type of thinking, I would then share a normative judgment with teachers, a first politics on the appropriate relationship between this sub-type and the rest of thinking. Specifically, I would argue that our job as teachers is to help students think better in all areas of living, in all of their thinking. I would then define thinking better as bringing all thinking under the control of reason and compassion. To be human is to be able to put oneself in the position of others, understand how they feel, and share feeling with them. This is what I mean by compassion. The human journey—your pilgrimmage, E.—is one of learning how to order thinking and thus to control passions by the procedures of rational thought, that is by reason. Therefore, what is called rational thought, including all those familiar names of syllogisms, logic, critical thinking, mathematics, the dialetic, and the like, are the most important ways of thinking; by learning to think reasonably, one learns to think better, about everything.

Reenter Descartes and R.W. Emerson. Here I would re-present the twin images of the pure, helpless, chaotic, disillusioned thinker on the one hand, the rational thinker of a doubted-away universe, and on the other hand, the aggressive, assertive, natural thinker, R.W.'s self-reliant thinker. Combining these two images, I would suggest to teachers that they think of students as people whose thought is naturally confident, loud, and constant, but on the other hand, usually more than half wrong. So, the first rule of teaching must be: insist that the

students assert their thoughts openly and constantly. Before trying to help them think well, make the classroom safe for their thought. A human being thinks about everything; each is a natural philosopher. But tricked by the illusions of our senses and the ideas of our peers, we assert in ignorance and error before learning to assert truly and well. But, no teacher can expect the silent, seated, shut-down student to learn to assert reasonably; such silence and non-assertion only kills the thinker even as it claims to transfer knowledge. The child has to be allowed and encouraged to be exuberantly assertive in order to know what they assert; otherwise they will forget what they think or reserve their thinking for other company, even as they learn to parrot official thoughts. The sequence then is a classroom safe for assertion, of error as often as truth; followed by the use of reasoning processes to doubt the world away, reachieving wonder; followed by the rebuilding of the world through the newly learned tools of reason.

This would get us to Whitehead's truth. There is only one curriculum, life as the child experiences it in the "insistent present." The teacher teaches thinking in teaching anything, any topic, any subject, any performance. And the context of that teaching is the child thinking in her or his insistent present. Thinking is not a special topic, or a segmented part of the curriculum. It is all of the curriculum and the responsibility of every teacher. In dance and sport, the body thinks. In writing, the hand thinks. In science, the eye thinks. In speaking, the mouth thinks. In mathematics, the inner eye thinks. In a sense, thinking is all that is taught. I am not saying here, of course, that there aren't crucial disciplines—reading, writing, speaking, debating, and calculating are crucial skills, the forms of thinking and discourse; mathematics, art, music, and science are crucial disciplines. These are irreplaceable means to teaching the thinker to think better, and about everything.

Finally, following Israel Sheffler and of course Socrates, I would argue that all knowledge is self-knowledge and that each thinker educates oneself. Therefore, teaching should be seen as a process in which people are helped to exercise judgment. By exercising judgment, thoughts are transferred. All we can do and best do as teachers is share content—knowledge, procedures, skills, and performances—to the accompaniment of reasons. In sharing reasons, we allow the student to understand our assertions, both of belief and principle, and to judge for themselves. By thinking with people, we allow them to think with us, both in agreement and difference. Teaching is the sharing of worlds through co-thinking, the co-thinking of contemporaries who happen to be of different generations. As such, traditions are continued, recreated, extended, and superceded. Valued worlds are reinvented.

E., that is the gist of what I intend to say on March 26. Any reactions?

Your brother in thought,

Will Callender

On March fourth, I received E's response, which was lengthier and more critical than I had expected. Frankly, I had anticipated a short note of approval and encouragement. The letter in total is not worth full duplication, nor is that necessary here. I limit myself to the sharing of key paragraphs which bear most directly on the advice I had given to teachers. Of the quality of that advice he says,

> Perhaps, you're too nice to teachers or make too much money doing staff development workshops to afford the cost of telling the truth. Being unemployed

myself, I'm not burdened by a similiar deficit. The truth is that the current educational system is not set up to nurture thinkers. Rather, its aim is to fill positions in the division of labor. The subject taught is given greater importance than the learner and the job for which it is considered preparation is given more importance than the general education, being, and citizenship of the student. Liberal education, that is education to liberate the thinker in the person, has lost out to vocational education, education to place the student in a job.

That is perhaps why we have this current fad toward critical thinking. To put the case directly, teachers tend to be wrongly encouraged to teach children "how to think" in segmented roles rather than to discover and nurture the thinker in themselves. Children are, for example, encouraged to think rationally in mathematical and scientific reckoning, but to obey authority when it comes to morality, ethnicity, national conduct, sexual activity, and religion. In a kind of switch-on, switch-off system, rationality is sanctimoniously crowned as good and operative in a research lab, in engineering, in computer science and in calculating people's profit margins and taxes, but heretical when it comes to concepts of God, bodily urgings, and national conduct. The diffusion of curriculum is not acccidental. The dominant value now is on a docile, weak, compliant person—a consumer, a non-thinker—who is simultaneously a rational crackerjack at paid work.

But now, as always, democracy and strong institutions depend upon people who arè fully informed, reasonable, and responsible, citizens who can and do think deeply about everything, not just in narrow fields of inquiry. We need thinkers, we need "Man Thinking."

So here is a little list of the enemies of thinking and democracy: blind trust; obedience; fear; power; reverence; guilt; shame; manipulation; anxiety; fraud. In short, the basis of compliance on which so much of nationalism, fake religion, sales, advertising, and employment rests. And I should include one of the biggest enemies of thinking—'the do it because I said it/you owe it to me' basis on which so much family life is organized.

So, the rediscovery of critical thinking is only a sign that even the little thinking required in segmented jobs is absent. Well, I am here to tell the world that you can't restore thinking without valuing the thinker. And, everything I see tells me that in educational institutions the thinker is dead.

Will, we need revolution, not reform.

I wrote E. a short letter of appreciation, admitting also that he was still too bold and daring for my tastes, and, yes, possibly my pocketbook as well. To my way of thinking, revolution meant turning the world over again and reforming it. If that was what he meant, I certainly was with him on re-volution; it appears that real reform and revolution are the same thing. I told him I would welcome still another pass of the circle on the topic of thinking when he joined the class the following week. I warned him that the other members of the class were more conservative than either of us, although I couldn't tell him in all cases what was being conserved. I suggested bringing them in on the discussion. It can get boring talking only to yourself.

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NORMATIVE THINKING

Joseph Grange

Two types of thinking now dominate our culture. For purposes of public discourse **objective thinking** reigns supreme. Its essential marks are reliance upon the observable, the measurable and the quantifiably reliable. It seeks mathematical expression and is satisfied when its results can be set forth in terms resonant with numerical calculation. Phrases such as "60% of all respondents..." or "the correlation between median income and voter choice..." are representative types. Its prose is flat but confident; its tone serene and unquestionable. Most revealing is the fact that its conclusions are presented in the declarative mood so that the reader is given little choice in terms of reaction. A neutral display of fact-based information is presented: reaction is neither desired nor expected.

Subjective thinking, the other dominant mode of cultural thought, is value-laden and often employs the subjunctive mood as it seeks to engage the reader's attention. Its distinguishing features include hortatory appeals, emotional discourse, hyperbolic rhetoric, and often rather shameless attempts to cajole, trap, and seduce the reader into agreement. Phrases such as "would that..", or "none but an insensitive..." signal its presence. The aim of this kind of thinking is the establishment of links of agreement, shared modes of identity and unqualified acquiescence in the general movement of thought being presented.

Though both types of thinking have earned their place in our age, their struggle to attain respective dominance has left no clear victor. Both are useful, both will continue to be employed and each will, most assuredly, consider the other to be an inferior mode of thinking. Their mutual antagonism seems inevitable and, sad to say, of not much consequence in advancing the cause of civilized discourse about issues of great importance. Left to themselves, these modes of thought can do little more than berate each other and hope that swings in public opinion bring them into periodic favor. This state of affairs is as it should be for neither way of thinking posseses any metaphysical ultimacy.

There is, however, another way of thinking that attaches supreme importance to metaphysical adequacy. I call it: **normative thinking.** Its place in the history of philosophy is an honored one with Plato as its primary historical representative. In more recent times the thought of Alfred North Whitehead (1929; 1933) can serve as an illustrious example. As I will attempt to show, both objective and subjective thinking owe their power to this foundational way of thinking. Normative thinking is ground and guarantee of these other secondary modes of thought.

Normative thinking is tied to a metaphysical theory. Our first task is, therefore, to sketch in general terms its major features. These principles will, in turn, reveal certain dimensions that thinking must take account if it is to be judged an adequate portrayal of reality. Finally, these domains of reality will be employed to establish the basic criteria by which good thinking can be measured.

A Metaphysical Sketch. Everything that we know in the temporal world is what it is because of its relations. In fact, the reality of the world is grounded in relationships. One corollary of this principle is that we cannot speak of things at all. Therefore: let us call everything that truly is an **event.** Events come to be and perish: their perishing is the birth of a fact. Facts are the touchstone of objective thinking. The coming to be of events is marked by their internal intensity: this felt domain is the source of subjective thinking. Neither type of thinking

concerns itself with the conditions, categories, and formal structures underlying this metaphysical process. Normative thinking seeks to describe, explain and justify this foundational process. Its purpose is to identify and use the norms whereby this universal process arises, expresses itself, and becomes an ever-advancing layer of fact in the building up of the universe.

The temporal world is the scene of the activity of finite creatures. As finite they are determinate; that is to say, they possess specific identities that are the outcome of the perspective they employ in order to focus the indeterminate nature of their environment. Events become real by reason of the way in which they shape the opportunities for being that are at their disposal. What this concretely means is that every real event has a structure. A structure is a way of having identity and difference together such that difference contributes to identity and identity respects difference for its contribution. In weaving difference onto identity a structure participates in a value which then becomes a norm by which that structure can be measured. This participation by structures in values is at the very heart of normative thinking. To the degree that an event realizes a value in its creative self-becoming, to that same degree it can be judged as a relevant success or a disappointing failure.

Thus, when we characterize something as good, we are really noting that an event has established a good way to be. Goodness is not simply a quality inherent in a thing but rather is an expression of the measure to which an event has realized its ideal. We speak, therefore, of a good basketball player as realizing to a certain degree the goodness that should be reflected in the event of playing basketball. Similarly, an orange is good when it matches the norms for goodness that should be inherent in its structure.

Harmony is the term Plato uses for this process of structuring the world so that a single unique event having its own subjective intensity and objective facticity comes to be. A harmony is a good way to be because it "fits" together the objective diversity of the world and the creative unity of the nascent event. When, therefore, we say that something is good we are actually remarking on the way in which it brings together the complexity of its environment and the simplicity of its aim. Every harmony is a value since it achieves a togetherness of parts by reason of an ideal way to be. Of course, no harmony is perfect and there are degrees of success and failure in all efforts to become real. The point is human thinking can estimate the levels of approximation to the ideal by reason of the norms it uses in making judgments. This is the fundamental usefulness of the Platonic theory of Ideas. The Ideas are the forms used by creatures to make real what is ideally possible for them. Normative thinking can establish these ideals and estimate the degree to which creativity has succeeded in allowing them to ingress into the temporal world.

We can summarize this metaphysical sketch by saying that: **to be is to be a harmony.** Every harmony must exhibit two features. It must possess complexity and simplicity. Complexity is required because being is relational and the relations possible in the universe are indefinite, myriad, and inexhaustible. It must exhibit simplicity because every event is just itself; that is to say, every event has its own unique identity. Simplicity is the way in which the universe receives a special focus in the perspective provided by the aim of the event in question. To use ancient but still powerful words, everything that comes to be does so by solving the problem of the One and the Many. The many are respected by complexity; the one is the result of simplicity. Still: a harmony is more than these two features since it does something unique—it harmonizes the universe from the perspective of the event in question. A harmony, therefore, has a third unique aspect: it creates something new. The novelty that inheres in a harmony springs from its envisionment of what is possible for it. We have already noted this dimen-

sion in speaking of the value which a structure seeks to incorporate in its coming-to-be. A successful harmony maximizes that value by minimizing features irrelevant to that ideal. No harmony can be completely successful since the creatures of the temporal world are finite, specific, and limited instances of creativity. We can restate Plato's Form of the Good this way: goodness is achieved when an event brings together in a fitting way the complexity of its environmental situation under the simplicity of the value it seeks to realize and express. In Whitehead's famous epigram: "the many become one and are increased by one."

Nature is, therefore, a mixture of unity and diversity. The combination of these two factors varies from occasion of experience to occasion but the basic format of self-creation remains constant. In this way the foregoing metaphysical sketch brings together certain universal features of the science of being: identity is the outcome of the unity impressed on the environment by its self-creative creatures; difference is the result of that effort as seen from the perspective of a judging entity. With the mention of judgment we are in a position to bring this metaphysics to bear upon the question of thinking.

Normative Thinking. When the level of creativity in nature reaches that of the human, we are dealing with an entity that for the most part reacts to its environment by judging it. In effect, this amounts to **thinking.** To think is to estimate the value of what is thought about. This is a natural process practiced by all humans, though obviously, some do it better than others. What I wish to emphasize is the valuational element in thinking. This is a direct result of the metaphysics just sketched.

Normative thinking has an obligatory value for it is demanded of temporal creatures that they come to terms with their past, react to it in the present and judge its significance for the future. Thus, every temporal creature lies along a triadic time line. The past, the present, and the future constitute the temporal zones of its being. For our purposes, we are restricting our analysis to the human level. In principle, however, it is possible to show how each of these temporal moments have their play within the arc of becoming that constitutes every natural entity. In terms of human temporality thought moves through these zones in the following manner.

The past registers its presence through feeling. We never merely react to the past but rather accept its presence through a process of feeling its worth. This process can be entirely conformal whereby we simply repeat the past in all its characteristics. When this is the mode of reception we are in the realm of physical matter; in effect, this is the inorganic kingdom. There is a necessary obligation for humans to feel their past since this region is for the most part the ground of stability and order. Without order no significant value can be achieved for it would be swallowed up in the onrush of time. The immediate past of a human being is the body with all its antecedent states but this past also includes our culture, traditions, and institutions. What is important to note is that the past is the necessary base out of which originality and spontaneity arise. Without it little of significance can occur.

The present is the moment of original individuality, that phase of time whereby spontaneity asserts itself so that genuine novelty can come to be. Change and creativity is entirely due to the present and its operations. The past cannot change since it is no longer; the future cannot change since it is not yet. Only within the temporal dimension of the now does originality assert itself. Therefore: for human beings the present is that time zone within which their real contribution to the process of reality can take hold. We may bring together the past and the present in this way: the present feels the past so as to take account of it in a novel way. This novelty can be as minimal as simply feeling what was then now or as maximal as feel-

ing the past in an entirely different way. This is what happens in a successful therapy program. The scale of novelty is not at this moment a question. It varies from person to person and situation to situation. What matters is that decision in the present moment alters the past and thereby lets real novelty enter the actual world. But humans are distinguished by their continuity; that is to say, human beings show concern for the future. In the present moment, therefore, there is always the real presence of the future. It is this intersection of the present and the future that marks the emergence of judgment. Judgment entails a concern for the present as it slides into the future. Normative thinking expresses itself most clearly in this phase of time's development.

The future is the not-yet that the present takes into consideration in estimating its novel reaction to the past. In other words, humans aim not simply at satisfaction in the present but also in the relevant future. To be concerned with the future is to show concern for how it will be. But to be is to be a harmony. Thus, to think about the quality of the future is to concern oneself with the possible harmonies emergent from those decisions made in the present. This is a natural act of judgment carried out by all those conscious of the flow of time. Animals do it and so do humans. We are concerned with finding out how to do it in a good way.

Recall the situation facing each human being. The past must be faced, a unique self created in the present and the claims of the future must be satisfied. Effective human thinking must employ some norms by which these obligations can be satisfied. There is, thus, a phase of conformation (the past), a phase of origination (the present) and a phase of efficacious satisfaction (the future). Without a way of evaluating these temporal phases, the human being has only two options. It can either **objectively** mirror its past and thereby deny the reality of time or it can **subjectively** express its being and thereby deny the past and the future. Neither solution is in accord with the full sweep of natural process for both distort some dimension of temporality. Without norms, human judgment fails the test of adequacy since it is insufficiently equipped to estimate the range of possible goods. This, of course, does not stop humans from proceeding without norms: that is one measure of the decay of a culture.

There is available in the history of western philosophy a set of norms for thinking. This schema is also in tune with the metaphysics we have sketched. The norms are to be found in Plato's Divided Line where he sets out both the domains of thinking and the various norms that govern their successful completion. In the sixth book of *The Republic* Socrates is at pains to try to show that all thinking is not equal but rather congruent with the experiences that are to be thought. Thus we arrive at four levels of thinking:

1. **The domain of imagination** which is characterized by discrete images and opinions reflecting the seeming importance of such things. This is the realm of "guesswork." One could be correct, one could be wrong; but one would never know why one was on the mark or off it.
2. **The domain of interpretation** which is characterized by experiential effort that renders more and more truth as experience becomes funded in the history of the knower. This is a realm of "know-how." As long as experience stays within its steady routine, success is likely. Here, too, the knower does not know why the truth is achieved. Rather, success comes about as a matter of practice.
3. **The domain of theory.** Within this realm, the knower is granted a certain level of universality for theory seeks the greatest stretch of application. Theory provides a measure of permanence to the effort of thinking. Here we are at the level of "knowing-that." When a theory is truly known, the knower knows that this is so because the theory provides a unity of application based on principles rather than a fund of experience. Theory seeks to embody an explanation for the truth of interpretation.

4. **The domain of responsibility.** This realm seeks to know why something is the way it is. Furthermore in a Platonic universe, everything in some way is good. Thus, to know why something is the way it is, is also to know why it is good. In other words, responsibility is the way in which humans think so as to come into proximity with the good. Responsible thinking "knows why" something is a good way to be.

These four domains of thinking are governed by four respective norms. The domain of imagination is governed by the norm of **Beauty,** the domain of interpretation is governed by the norm of **Truth,** the domain of theory is governed by the norm of **Unity,** and the domain of responsiblity is governed by the norm of **Goodness.** Note that goodness is all through the other domains since beauty, truth and unity are a good way for imagination, interpretation and theory to be. Similarly, unity is all through truth and beauty since interpretation and imagination require its presence. Also, a theory should manifest truth and beauty if it is to be both important and compelling. Truth is what is important and, therefore, the norm of beauty is related to the domain of interpretation in the sense that whatever is truthful should also be engaging. Finally, beauty is that norm by which the imagination presses closest to the real because the beautiful is that which compels attention and engages us. An imaginative entity that does not engage our consciousness is not in any important sense a success. The very meaning of the imaginative is the arresting: beauty is the quality which engages our attention.

These four norms—**Beauty, Truth, Unity, Goodness—**are continuous with each other and overlap in the harmonic flow of reality that is process at its most intense. They represent the best way to think when we are operating in the specific domains in which they serve as guides. Thus: when we wish to think imaginatively, a good way to think is in the most engaging or beautiful manner. When we wish to think in an interpretative fashion, it is good to think truthfully. When forming a theory, it is good to seek unity. Finally, when we wish to think in the most responsible fashion, we must think of a good way to be.

The justification of normative thinking is found in its results. What is more, normative thinking can satisfy the requirements of both **objective** and **subjective** thinking. This is because it is wider and more foundational than either of those ways of thought. Wider because it spans all the dimensions of time. Foundational because it supplies to those types of thought the very norms they use in judging themselves. In other words, subjectivity is possible because of the norms it embodies; objectivity is possible because of its respective norms. Neither supplies its own norms but must look to normative thinking for appropriate justification.

Equally important, normative thinking guides the four domains of human thought to their appropriate satisfications. Imagination rests in the presence of beauty. Interpretation stops at the place of truth. Speculative theory is finished when unity is achieved. Responsibility is over when goodness is achieved. In this way, the desire of thought to be complete is moved towards its conclusion. Of course, in a process universe such completion is impossible: totality is no goal of normative thinking. Still: some guidance has been had since the beautiful, the true, the one and the good have received at least partial exemplification in the realm of actuality. Specifically, those using imagination know what norm should guide their effort if they are to seek their own and others' satisfaction. To be imaginative is to express beauty. Anything less is unworthy of such thought. To interpret is to seek truth. Anything less is unworthy of the interpretant's intention. To theorize is to seek unity. Anything less is not theory. To think responsibly is to seek to manifest goodness. Anything less is not a good way to think.

What is important to note is this brief examination of normative thinking is that each mode of thought is valuational for what drives it forward is the aspiration of normative ideals. Thus, those in need of felt satisfaction strive through imagination to attain the norm of beauty. Artists do this. Those who seek concrete results strive for truth in the sense of selecting out what is important. Scientists do this in their different disciplines. Those who strive for explanatory power seek the unity of a testable theory. Philosophers should do this. Finally, all human beings seek the Good insofar as they know it since the Good gives happiness. Responsible thinking brings us into the presence of the good and therefore it is in human self-interest to think responsibly.

Normative thinking is justified by its results. The following diagram sketches both the results obtainable by normative thinking as well as the norms to be used in the various domains of thought.

Types of Thinking	*Appropriate Norm*	*Justified by*
Responsibility	**The Form of The Good**	**Happiness (A good way to be)**
Theory	**The Form of Unity**	**Explanatory Power**
Interpretation	**The Form of Truth**	**Important Results**
Imagination	**The Form of Beauty**	**The Feeling of Engagement**

This analysis of normative thinking can be concluded by summarizing the three obligations that time imposes upon humans in their effort to think:

> First, in feeling the past we are under the normative responsibility of faithfulness to its experiential content. Denial will not do. Second, in our spontaneous self-growth in the present we are under the normative responsibility to create novel thoughts actually relevant to our existing situation. Otherwise we live in fantasy.Third, in our intentional attitude towards the future we are under the normative responsibility to seek the embodied presence of Beauty, Truth, Unity and Goodness. Otherwise we are irresponsible and unhealthy.

This last reference to health underscores what I take to be the very meaning of normative thinking. Human health and happiness depend upon the wholeness of our being. Thought is one way in which that wholeness can first of all be sighted and then achieved. The demands of time are such that a **measure** must be found against which the possibilities of life can be ranked. Neither objective nor subjective thinking can locate that measure. Normative thinking is precisely the effort to recover that measure which is appropriate to our specific, concrete time.

If this effort to lay out the meaning and significance of normative thinking has been successful, then a new understanding of metaphysics becomes possible. Indeed metaphysics is abstract (which is why most people don't enjoy it) but its aim is to shelter and protect the concrete. Metaphysics, properly done, elucidates the present moment in all its shining value and all its rich potential. Thus, to think normatively is to do metaphysics. And that is a good way for a human to be. Without such rigorous cognitive activity, triviality triumphs and the power of a civilization to counteract such entropic forces shrinks. To think normatively is to stand against the forces of decay. Nothing worthy of the human can last for long without a measure of excellence. Such measures are to be found in the real world if normative thinking can be restored to its proper eminence.

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RE-COVERING VS. RE-COVERING OR 'THINKING THROUGH' THE QUESTION 'WHAT SOCRATES BEGAN'

William J. Gavin

The overall theme of this symposium is entitled "What Socrates Began: An Examination of the Intellect." The specific theme of this session is entitled "Promoting Thinking through the Disciplines." I propose in my comments today to act as I believe Socrates himself might have acted with regard to these two titles. In so doing, I hope to reveal, in an indirect way, what I believe to be the spirit, if not the letter, of Philosophy.

How, then, would Socrates have reacted if confronted with these two themes? Hazarding the pitfalls involved in any reconstructive analysis, I would venture to state that the very first thing Socrates would want to do, and would want us to do, is NOT to take the meaning of these titles for granted. The most significant item in the first title is the colon. At first glance, it purports to indicate an answer to the questions, "What did Socrates begin?" Answer—an examination of the intellect. But surely this is exactly what is at issue. What, if anything, did Socrates begin? We ought, I would argue, to refrain from privileging an immediate, or over hasty, answer to the question. We ought, in short, to avoid invoking closure by interpreting the very title of our symposium too simplistically.

First of all, let us recall what we know, or more important, what we don't know, about Socrates. The man himself wrote nothing, preferring, from what we can tell, the activity of Philosophy as engaged inquiry. We have no written words, no text of Socrates, lying around waiting to be read off like a note from the dentist. Indeed what we know of Socrates comes from three portraits, one by Zenophon, one by Aristophanes, and, or course, one by Plato, his disciple.[1] It is the last that provides us with the most detailed account, but surely it is not a completely detached representation. It is, for example, difficult to know when Socrates is speaking, and when Plato has inserted his own ideas into the character of Socrates. Even when we leave aside the fact that there are other accounts, and the fact that Plato is not neutral, and the fact that we cannot get at the source, but are left rather with only a "trace," with no original recoverable,[2] what does the portrait look like?

The portrait is, I would argue, an ironic one, complex, revealing and concealing at the same time.[3] In *The Apology,* Socrates first tells the "jury" that they will not hear any fine speeches from him; he then proceeds to give a speech which is a model of forensic excellence; and thirdly, the speech doesn't work.[4] Accused of believing in gods of his own invention instead of the gods recognized by the state, and of corrupting the young, he reclassified the charges, announcing that he is more concerned with old accusations that the inquires into the things below the earth and in the sky, and, that he made the weaker argument the stronger, and takes fees.[5] Having privilieged this accusation, he announces that he can't defeat it, because he can't confront his accusers; there is, again, only a trace. When his friend Chaerephon went to the oracle at Delphi and asked, "Is anyone wiser than Socrates?" the oracle responded, "No one is wiser." Ignoring the ironic ambiguity of the response, what did Socrates do next? He tried to disprove the oracle by finding someone who was wiser than he. Or, perhaps better, he reacted, not to the oracle but *into* the ambiguity of the oracle, so that the meaning of the oracle could be constituted by his activity.[6] The oracle, like the text, is ambiguous, and within the text the portrait of Socrates is ambiguous. In the text he notes that the true

meaning of the oracle must be that he is wisest only in this, that he now knows that he doesn't know what he once thought he knew, whereas other people think they know but don't. What then, did Socrates begin? Is this what he initiated—getting people to realize how little they really knew? Was Socrates being disrespectful of the oracle in trying to disprove it, or rather was he trying, hermeneutically, to interpret the meaning of the text (if we can call an oracle a text)?

Socrates is often claimed by various traditions in Western philosophy as being the first of their number. Is he the first analytic thinker, and is philosophy to be primarily seen as a form of logic? Or, is he, on the other hand, the first existentialist, exemplifying by his life the difference between an authentic and an inauthentic existence? Between making it and faking it? Plato himself is not overly helpful here, giving us at least two pictures of Socrates: one in *The Phaedo,* and a different one in the Symposium. *The Phaedo,* for example, presents Socrates as an ascetic, as rather cerebral, perhaps viewing the body as a trap, or a tomb for the soul. However, even this dialogue has its ironic side. Several so-called "proofs" for the immortality of the soul are given, but perhaps the most important thing about them is that they don't work. To prove that there's no such thing as a dead soul is not to prove that the soul exists and that it's immortal.[7] There is logic employed in this dialogue, as in all the others, but the net effect is somewhat ironic. The result of thinking critically about the soul is the realization that the soul cannot be caught in the snares of reason—though ironically enough it is only through reason that we come to realize this. The thinking in *The Phaedo* is rigourous, but it is also playful, in a serious, undermining sort of way. Socrates is, after all, about to die. In this dialogue Socrates says, "those who really apply themselves in the right way to philosophy are directly and in their own accord preparing themselves for dying and death."[8] Is this then, what Socrates began? How does one prepare for death? Death is not an object that one can confront, and there's no guarantee that the death one decides to await will be the one that actually shows up. Indeed one of the disclosures in the dialogue is that we cannot wait for death per se; we can only await a particular form of death.[9] Socrates, in *The Apology,* and here in *The Phaedo,* has decided to await, to attend a particular form of death; he has through proposing free room and board as a counter-penalty, forced the polis to either terminate him or to tolerate his questioning. True, Socrates is famous for the idea that "the unexamined life is not worth living." But what is also the case, though often overlooked, is that on many crucial issues, such as that of death, and of the immortality of the soul, the questioning ends in aporia, in realizing that we don't know what we thought we knew. If there is a final proof of the immortality of the soul in *The Phaedo,* the proof of the pudding is in the drinking so to speak, i.e., in praxis, in the actual existential commitment of Socrates, in his willingness to die for his beliefs, which beliefs, when subject to critical analysis, remain open-textured, and essentially so.

In sum, I think it is important to "think through" what Socrates began, because it makes a great deal of difference whether we see him as just a critical thinker engaged in problem solving, or whether we realize that he is a person engaged in thinking, situated in thinking, and not at all neutral about the outcome of the investigation. Reasoning plays an essential role for Socrates, but it does not play the only role; it is necessary, but it is not sufficient. Socrates is not a disembodied or transcendental "cartesian" ego, wondering whether or not to get involved with life. He does, indeed, stand for the spirit of free inquiry; but too often it is assumed that the result of that inquiry will be an answer; more often than not it is simply the reformulation of the original question at a more complicated level.

In an insightful article entitled "Teaching Critical Thinking, Part One: Are We Making Critical Mistakes?", Professor Robert J. Sternberg suggests that what often passes for critical thinking differs significantly from the problems students will eventually face in the real world.

Among Sternberg's comments are the following points. First, in "*the everyday world, the first and sometimes the most difficult step in problem solving is the recognition that a problem exists...* Training students to solve problems already posed for them does not train them to find and select important problems on their own."[10] Second, in "*everyday problem solving it is often harder to figure out just what the problem is than to figure out how to solve it.*"[11] Going further, in "*everyday problem solving, it is not usually clear just what information will be needed to solve a given problem, nor is it always clear where the requisite information can be found.*"[12] In addition, the context of a problem is important, though usually it is ignored. "*The solutions to everyday problems depend on and interact with the contexts in which the problems are presented.* Problems in books are ususally decontextualized."[13] And finally, for Sternberg, "*[e]veryday problems generally have no right solution, and even the criteria for what constitutes a best solution are often not clear,*"[14] oftentimes depending as much on tacit knowledge as on formal knowledge.

It seems to me that Sternberg's criticisms of critical thinking do not, I repeat do NOT, apply to what Socrates began—but only if we take, i.e., interpret, the dialogue correctly. First of all, Socrates' procedure is to "trick" people, through questioning, into realizing that a problem exists, to get them to realize that they don't know what they thought they knew. This is therapeutic and sometimes painful. Also, as we shall see, it's sometimes debatable as to what the problem really is. Secondly, although there is in some sense, progress in the dialogues, if I'm right about Socrates being wisest in knowing that he doesn't know what he thought he knew, then what goes on in the dialogues is a continual reformulation of the problem. This leads me to the third, and most important point about the Socratic texts, namely, the CONTEXT of the text. Who Socrates is speaking with, what the subject matter is, how a specific dialogue ends, what Socrates leaves unsaid, or says indirectly, what he argues for existentially by his acts, his praxis, based on commitments which in some respects transcend the bounds of logic—all these need to be taken into consideration when we reflect on "what Socrates began." Going further, every time we consider these texts we are actually RE-considering them in the context of the present. We are, you and I, remembering the past, but every remembering of the past is not simply a recollection; it is also a re-MEMBERING, a re-structuring of the past, a re-classification of what items in the past are to be deemed important, and of which ones are to be marginalized.

As one looks at the text of *The Apology,* or of any other number of dialogues, it is too easy to say, "What is the problem?" The problem here is impiety, or justice, as seems to be the case in Book One of The Republic. One can then, of course, go on to ask, "How does Socrates SOLVE the problem? One can't, of course, get too far with this approach, for at least three reasons. First, Socrates doesn't solve the problem; he doesn't tell you in Book One of The Republic what justice is. The book ends in a sense of "aporia," of "knowing that one doesn't know what one thought one knew" about justice.[15] Many of the dialogues are of this nature. Phaedo: problem—the immortality of the soul, please prove. Result: indeterminate. Or take the Meno. The problem is, is virtue teachable? Answer—again, on the face of it, indeterminate. Or take that most "logical" of dialogues, The Parmenides, where the young Socrates "learns" that "if the one is, i.e., exists, then the one is actually two, is unity and existence."[16] Answers to these types of problems always end in aporia in the texts, and indeed they have to, for Socrates has told us that he is wiser only in that he doesn't know what he once thought he knew.

Second, pulling out, or privileging the surface features or the text like this ignores too much. It ignores, for example, the fact that most of the dialogues end with a myth, or a story, or a narrative, that myth takes place after, not before reason, or critical thinking, has done its work, that myth becomes more and more important in the dialogues, occupying, for example, the central pivotal section of The Republic, and the end of the dialogue.[17]

Third, this approach ignores one fundamental aspect of the text, and that is, that the problem is often up for grabs. What is actually on trial in *The Apology?* On one level it is Socrates, but on another level Socrates has put Athens on trial. That is, he, by his counter-proposal of free room and board at the city's expense, has forced the Athenians to decide whether their city can tolerate self-examination. On a third level, it is Philosophy that is on trial in *The Apology.*[18]

In short, the Socratic texts are opaque, and, as such, allow for different interpretations to arise. One can emphasize Socrates as critical thinker, but to do so ignores much of the text, as well as subjecting Socrates to Nietzche's criticism that his (Socrates') reasoning techniques were merely a distraction, a denial of the illogical and atavistic dimensions of life.[19]

I'm not saying that Socrates is merely in the eye of the beholder—that we can see anything we want in the texts. This would simply render the text superfluous. But it does seem to me that there's more than one Socrates hiding in the text. Besides the logical Socrates, there's the religious Socrates, the unknown Socrates referring to his unknown god; there's Socrates the Athenian, the city-dweller who nonetheless goes symbolically outside the space of Athens to the Piraeus in The Republic, and who goes outside the walls of the entire city in the Phaedrus, and who suggests, at least at times (e.g., *The Apology*) that civil disobedience is permissible. There is, finally, or non-finally, the ironic Socrates "laughing up his sleeve at all the world," as Alcibiades says in the Symposium.[20] These are not mutually exclusive Socrates—but I would argue that we should not succumb to a reductionism in suggesting that one specific portrait is the basic or foundationalist one. The ambiguity or the text should be nurtured and preserved.

Finally, what we tend to forget as we look at Socrates in the text is that he's STILL looking. Even in *The Phaedo,* where he is dying, he's still trying out various hypotheses. The self or person is not an object or billiard ball to be examined in a detached fashion. Socrates, in brief, did not begin problem-solving. It's rather hard to say what he DID begin, but whatever it was, he didn't finish it either. He discusses topics which are of concern—he's not neutral, or uninvolved with them. He doesn't simply take up any topic and argue forcefully or logically for it. This tactic would place him much too close to the stance of the sophist, the group he most distrusted, and, ironically, how he himself was perceived as by society at large. The topics he chooses to examine are difficult ones: what is justice, what is courage, what is impiety, what is love, is there an immortal soul, can one prepare for death. These are again, items of CONCERN, not intellectual crossword puzzles. And it's difficult to say what he finds out about these topics, save, again, that a lot of people think they know a lot about them but actually don't. But one thing that is of importance here is that he doesn't turn away from these topics and select easier questions—questions with answers, more manageable questions, tame questions. Because of this very refusal to turn from the unanswerable, there's an ironic sense in which Socrates ends where he begins—with questions. He's still making a new beginning!

Can we afford to do less than Socrates here? I think not. Let us, then, in the spirit of Socrates, make a new beginning and turn to our specific panel. The title of our particular panel discus-

sion is "Promoting Thinking Through the Disciplines." How would Socrates react to this more specific title? Again, I think he would want us not to uncritically accept one meaning or definition of the term "thinking through."

At its most obvious level "thinking through" carries with it an instrumentalist connotation. It means "thinking by means of," thinking via some tool, utilizing one approach, as opposed to another. Thus, one would promote thinking by means of history, or by means of science, or by means of philosophy. I do not think Socrates would have accepted this definition, mainly because it would reduce philosophy to technique, to a "trivial pursuit," and, at least for Socrates, philosophy was a way of life, not just an analytical tool.

In a second sense, promoting thinking through the disciplines would mean thinking THROUGH a specific discipline to its end; to think through is to think out, to attain closure, to reach the end, the boundary or terminus of a specific discipline. I do not believe Socrates would have completely accepted this sense of the title of our panel either, for it connotes the sense of completion, of covering all the content of the philosophical discipline, and for him at least, that was something he never achieved. Even at the end, he knew that he didn't know for sure.

There's a third sense of "promoting thinking through the disciplines," one which connotes thinking outside of, disclosing the boundaries of, a specific discipline, indicating limitations of any claim made within a specific discipline. To promote thinking through the disciplines in this sense would mean weakening the supposed autonomy of a specific discipline, indicating that no one discipline has certain and undistorted access to reality. I believe it is this third sense of "thinking through" that is closest to the spirit of Socrates. While he used the discipline of analytic or critical thinking at times, he did not, I believe, view the latter as sufficient. Necessary yes, but sufficient no. Language, and its ideal form, logic, can be immensely liberating; it can also be insulating. It becomes insulating precisely to the extent that it is viewed as sufficient, as capable of revealing, copying, mirroring, once and for all, what is supposedly objectively "out there," or objectively "in here," i.e., the self or subject. Philosophy, for Socrates, is not reducible to logic or critical thinking, for the same reason that the spirit of the law is not reducible to the letter of the law,[21] namely, something that is important, namely the VAGUE or MYSTERIOUS,[22] is lost.

In the foregoing I have tried to be true to the spirit of Socrates. Just as he refused to take any definition for granted, so too I have tried to give some reasons why we should not take for granted what he began, or what "thinking through" means. My approach, as was Socrates, is logical, but, in the last analysis, it transcends the bounds of logic. It is an interpretation—one for which I can argue and give reasons, but not completely prove. As others have done through time, I am trying to indicate what the problem really is, perhaps a bit more candidly. and for me the problem is precisely NOT to succumb to a problematic analysis, but rather to indirectly disclose, and to nurture, the polyphonic diversity of the text and the *con*-text, i.e., all that goes with the text. Only in this way can we be true to the spirit of Socrates, who in the dialogue called the Theatetus says that "this sense of wonder is the mark of the philosopher. Philosophy indeed has no other origin..."[23] To preserve philosophy, which is what I believe Socrates would want, we must preserve some wonder as to what Socrates began.[24]

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FOOTNOTES

1. Cf. the discussion of this issue in Gregory Vlastos' "Introduction to the Paradox of Socrates," in The Philosophy of Socrates, A Collection of Critical Essays, edited by Gregory Vlastos (New York: Anchor Books, Doubleday and Company, Inc. 1971) pp. 1-21.

2. For the notion of a trace, cf. Jacques Derrida, Of Grammatology, trans. Gayatri Chakraverty Spivak (Baltimore: The Johns Hopkins University Press, 1974) p. 167.

3. For an analogous investigation, cf. Don Ihde's discussion of an "amplification-reduction" structure, in Technics and Praxis (Dordrecht: D. Reidel Publishing Co., 1979) p. 21ff.

4. Cf. Reginald E. Allen, "Irony and Rhetoric in Plato's Apology," in R.E. Allen, Socrates and Legal Obligation (Minneapolis: University of Minnesota Press, 1980) pp. 3-15.

5. Plato, The Apology, 18b-d, in Plato, The Collected Dialogues, edited by Edith Hamilton and Huntington Cairns (New York: Bollingen Series, Pantheon Books, Random House, 1961) pp. 4-5.

6. For the notion of "reacting into" a stimulus, cf. John Dewey, "The Reflex Arc Concept in Psychology" in The Philosophy of John Dewey, Two Volumes in One, edited by John J. McDermott (Chicago: University of Chicago Press, 1981) Vol. I, pp. 136-148.

7. Cf. J.E. Raven, Plato's Thought in the Making (Cambridge: Cambridge University Press, 1965) p. 103.

8. Plato, Phaedo 64a, in Plato, The Collected Dialogues, p. 46.

9. For a discussion of this matter, cf. the present writer's "En Attendent La Mort: Plato's Socrates, Tolstoy's Ivan Ilych, and Beckett's Waiting for Godot," in Soundings, Vol. LXIV, 2, Summer, 1981, pp. 217-232.

10. Robert J. Sternberg, "Teaching Critical Thinking, Part One: Are We Making Critical Mistakes?," the Phi Delta Kappan, November 1985, pp. 195-196.

11. Ibid., p. 196.

12. Ibid., p. 196.

13. Ibid., p. 196.

14. Ibid., p. 197. Sternberg's attempt to solve these problems is not considered here. See "Teaching Critical Thinking, Part Two: Possible Solutions" in the Phi Delta Kappan, December 1985.

15. Here I am confining my analysis to the first book of The Republic, referred to as The Thrasymachus, because that text was most probably written well before the rest of The Republic, and can stand alone as a properly "Socratic dialogue."

16. Cf. Plato, The Parmenides, 137a and following, in Plato, The Collected Dialogues, p. 931 ff.

17. Cf. Paul Friedlander, Plato, An Introduction (New York: Harper Torchbooks, Harper & Row, 1964) Chapter IX: Myth, passim.

18. Cf. Eric Voegelin, Plato (Baton Rouge: Louisiana State University Press, 1966) p. 8. "In the speeches of the defense three actions are going on at the same time: the trial of Socrates ending in his condemnation; the trial of Athens ending in the rejection of the Savior; and the separation of Socrates from the polis ending in the solitude of his death."

19. See, for example, Frederich Nietzche, The Birth of Tragedy and the Genealogy of Morals, translated by Francis Goffing (New York: Doubleday Anchor Books, Doubleday and Company, Inc., 1956) pp. 4-5: "What were we to say of the end (or worse, of the beginning) of all inquiry? Might it be that the 'inquiring mind' was simply the human mind terrified by pessimism and trying to escape from it, a clever bulwark erected against the truth? Something craven and false, if one wanted to be moral about it? Or if one preferred to put it amorally, a dodge? Had this perhaps been your secret, great Socrates? Most secretive of ironists, had this been your deepest irony?"

20. Plato, Symposium, 216a, in Plato, The Collected Dialogues, op. cit., p. 568.

21. Cf. Plato, Crito, 50a ff. in Plato, The Collected Dialogues, op. cit., p. 35ff.

22. For the notion of "problem" versus "mystery" see, Gabriel Marcel, Being and Having: An Existentialist Diary (New York: Harper Torchbooks, Harper & Row, 1965) pp. 100-121.

23. Plato, The Theatetus, 155d, in Plato, The Collected Dialogues, op. cit., p. 860.

24. This paper was also presented at a special symposium of the USM Philosophy Club, where it was commented upon by two philosophy students, Ms. Connie Pacillo and Mr. James Patnode, as well as by my colleague Professor Robert B. Louden. I am grateful for their insights and suggestions.

WHAT IS THINKING? A SEARCH FOR THE THOUGHTFUL CURRICULUM

Janice Travers

My chief questions in this paper are what is thinking and what makes for a thoughtful classroom. I have addressed my questions to three twentieth-century philosophers: John Dewey, Martin Heidegger, and Hannah Arendt. Each has addressed the subject of thinking directly, and to varying degrees the work of each has implications for the subject of education. That I have directed my questions to philosophers rather than educational psychologists or human development theorists perhaps requires some explanation. In asking the question, "What is thinking?", I am asking less for an operational definition suitable for use in classroom and laboratory research than for some meaningful conceptual framework for using the word itself. As such my inquiry may extend itself beyond the naturalism of science into language, history, and philosophy.

Before outlining some possible answers to my questions, I would like to offer an explanation for my interest in the subject of thinking. In the course of my own formal education I have heard both students and teachers assert from time to time that an education, particularly a university education, teaches a student "how to think." Upon reflecting on my own education, however, I am not at all certain what knowing how to think means.

The phrase "how to think" seems highly ambiguous to me. Does it mean how to reason toward a specific outcome, a mathematically precise answer or a technical solution that satisfies the parameters of a problem? Does learning "how to think" mean I have learned some technique? Or maybe learning "how to think" means the learning of an attitude, an attitude of questioning or doubt which demands clarification and meaning and aims at a heightened awareness. Both explanations imply an emphasis on the word "how" in the phrase "how to think," and both imply a certain skill or virtuosity. Still a third explanation might place the emphasis on the word "think." And this explanation may simply mean that an education initiates a student fully and finally into all that thinking means. In the course of examining the work of Dewey, Heidegger, and Arendt, I have come to believe that the last of these may represent the best explanation and that the problem for higher education is creating the conditions and the space large enough for thinking to occur.

Taking on the task of reviewing the work of three philosophers and some implications for education in so short a space as this paper is not cautious or wise. I have no doubt that errors and inadequacies abound here, and I hope that they can be forgiven. But even if it is only the erroneous here that gives us to think, something will nonetheless have been accomplished.

What Is Thinking?

In examining the work of Dewey and Heidegger, I was struck by the remarkable similarities of some of their views. Both are concerned with the human being existing in the world. Neither places the human being in the position of the passive observer of the world. Neither makes the human being the subjective and willful creator of the world. Both are concerned with the problem of time. Past, present, and future, memory and projects are features in the philosophies of both men. Both have a deep aesthetic sensibility, and both have a keen historical awareness of the decline of Western metaphysics with the rise of Western science. On the subject of thinking, however, the divergence in their views becomes clearly apparent. And it is the way each frames his question on the subject of thinking that introduces such a

divergence. Dewey's question (1933) about thinking may be summed up as this: How do we think in order that we may solve problems? Dewey's concern for thinking is restricted to an epistemology or a psychology of knowledge. And knowledge for Dewey is gained in the process of solving problems and a discovery of what works.

Heidegger, on the other hand, does not place such a restriction on the question of thinking. His concern is for thinking in a much more basic context, that of the ontology or an account of the Being of Dasein. "Dasein" is the not easily translatable term Heidegger applies to the existence of the human being who must project a future in the full awareness of death. Heidegger (1968) phrases his question about Dasein's thinking in a way that is difficult for us to hear. "What is called thinking?" he asks, and then he rearranges the syntax of the question in many different ways so that we are led to understand that it is a call from Being itself that brings Dasein to think.

What Plato called "wonder" may be articulated in Heidegger's question, "Why is there anything at all and not, rather, nothing?" (1977).[1] This amazement at sheer Being is what gives us pause to think, then, in Heidegger's view. The question hints at a divine mystery at the core of thinking. It hints at something irreducible and enduring in Dasein's world. Thinking takes on the aspect of the sacred implied in its root word "to thank." To think, then, is to give thanks for the sheer Being of a thing (1968, p.244).

In contrast, Dewey (1933) reduces the notion of wonder to "curiosity on the intellectual plane" (pp. 37-39). This curiosity is achieved through stages of human development, the first of which is an organic stage characterized by a vital overflow of energy which causes a child to get into everything. The second stage, the social stage, develops under the influence of social stimuli, and questions such as "What is that?" or "Why?" begin. The final stage of wonder, that curiosity on the intellectual plane, can be achieved only by attaching curiosity to more remote ends which control and bind a sequence of inquiries and observations into what we may properly call a problem-solving sequence. Within this sequence the human being learns to think consequentially. (Thomas Hobbes, of course said this earlier, better, and with greater originality, and much of Dewey can be read as a democratic footnote on the Hobbesian social contract.)

The ways in which a problem may be solved are not unfamiliar to any of us. We may collect facts, examine, test, and experiment our way to a solution and the end of a thought process. We may develop orderly methods. We may analyze and synthesize, apply ideas, organize meanings into specialized concepts. We may operationalize our definitions. What all this adds up to, of course, are the methods of science and technology, and it is difficult to challenge thinking in relation to the knowledge of science or technology which has achieved so much. It would seem wiser then not to challenge, but to supplement such a conception of thinking.

In comparison with Dewey, Heidegger's attempts at a new philosophy of thinking may appear insipid, even mystical. (His best known American critic, Walter Kaufmann (1956) suggests the adjective "pathological" (p. 39).) That Heidegger might characterize Dewey's notion of thinking as inauthentic doesn't hold much sway until we are prepared to ask once more my original question: What is thinking? This question does not ask only "What good is thinking?," "For what might thinking be used?", or "How can thinking be improved?" Dewey can answer each of these. But Dewey answers very few questions about the phenomenon

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[1]This translation is actually found as a quote in Arendt (1978, p. 145). It has been substituted for Krell's because of its simple elegance.

itself or its phenomenology. And by pinning thinking to the problem of knowledge as conceived in the terms of Western science, Dewey is prepared to jettison a good portion of the phenomena we often call thinking. Of what do the phenomena consist? Daydreams, habits, traditional beliefs, passions, imaginative flights of fancy, the stream of consciousness, and Baconian idols might be good way of categorizing them.

What Dewey is willing to cast overboard, Heidegger is eager to gather, but it proves, however, to be no easy task as Heidegger admits in his later work. Poetry, it appears, might offer a way of thinking that is closest to the enduring worldly home of Dasein. Heidegger's persistent theme is a line from the German poet Holderlin: "Poetically man dwells" (1971, pp. 213-229). Heidegger's new philosophy becomes difficult to follow, for it takes on fewer aspects of traditional Western philosophy. Its logic becomes less formal, more poetic as Heidegger wanders seeking a way in language and words. His philosophy of thinking becomes less an argument for poetic thinking than its pure demonstration in language. We cannot read Heidegger with the hope that he might lead once and for all to an answer to the question of what is thinking. The formal properties of Heideggerian thinking cannot be expressed in the abstract categories employed by Dewey. We can only hope to understand by listening hard to his language which is called to things whose Being appears through the words. For example, Heidegger says:

> The poetic character of thinking is
> still veiled over.
>
> Where it shows itself, it is for a
> long time like the utopism of
> a half-poetic intellect.
>
> But poetry that thinks is in truth
> the topology of Being.
>
> The topology tells Being the
> whereabouts of the actual
> presence (1971, p. 12).

What Heidegger seeks is not practical knowledge, but poetic truth, or what he prefers to call an unconcealedness. Language appears to be a key element in this search. The "topology of Being" is an area of revelation or an unconcealedness of a way or mode of being in the world, and poetry can explore this topology. Heidegger is searching for a way of thinking that finds a new opening for truth that can be found in neither Western metaphysics nor science. It is a way that is prior even to the notions of rationality or irrationality themselves (1977, p. 391). And Heidegger is prepared to abandon a 2500 year-old tradition of thinking in order to find a new way back to an old question.

I am not prepared to accept fully Heidegger's interpretation of authentic thinking. At bottom I remain ambivalent toward his work. What appears at one moment to hold the most marvelous insight descends at the next moment to the most mediocre sentimentlity as when Heidegger "dwells poetically" (1971, pp. 145-161) in a world of Black Forest peasant cottages, herds grazing at pasture, or the old bridge in Heidelberg. (Truly these are the utopisms of a half-poetic intellect.)

And, yet, there is something compelling about Heidegger's work: something so compelling that I (like many others) cannot resist the temptation to help find the way of thinking he seeks.

It is a way of which Heidegger speaks time and again but never affirms as the way of thinking he wishes to find. It is a way that was at the outset a poetry, the original poetry of Homer. It is not the same way of knowing as is offered by the sciences. It is, rather, a way of telling which for Heidegger lies close to thinking. It is the way of Mnemosyne, the mother of the muses so near to Heidegger's heart. That way, of course, is thinking historically, and what I am suggesting is that the philosophy Heidegger seeks is a history. The new philosophy, the new way of thinking he seeks is simply the mode or story that gathers the past and supplies Dasein with a meaningful world.

And, if I may speculate my way out on this limb even further: Heidegger fails to affirm openly historical thought as his new philosophy, because he refuses to tell his own history. The disappearance of Being he mourns is only his plain refusal to respond to its call. This refusal is what gives some of his poeticizing overtones of German nationalism without German history. It is what gives it an unsavory reactionary and sentimental character. What is genuine in Heidegger is the search for the meaningful philosophical alternative.

And I might add that it is perhaps only by way of historical thinking that Dewey's progressivist notion of thinking can be made to have meaning. Active problem solving thought sequences must have a context to hold an appeal for any of us. This context or historical matrix is summed up by Dewey in his vague but crucial term, "experience." And it is out of the American experience that Dewey himself poses the problem of thinking and proposes the progressive solution. For this reason, Dewey holds an important place in the history of ideas, and the cosmopolitan appeal of those ideas makes sense. But in giving ourselves to thinking of our more recent historical experience, we may find ourselves in the strange position of thinking toward the posing of new problems, problems that the philosopher Hans Jonas (1985) views as Faustian, problems that have arisen out of our scientific hubris and that faith in "reckoning with consequences." (And we shall be truly fortunate if they can be solved.) In this thinking Heidegger in his thoughtfully errant path has succeeded. The significance of his thinking lies in the posing of new problems by means of a radical ontology which questions the rationality of a purely scientific reasoning.

At this point I have briefly outlined Dewey's prescription for thinking and Heidegger's display of thinking on thinking. What remains is to speak of the phenomenon of thinking as it has appeared to those who think. Here it is Hannah Arendt who offers the re-search on the subject with an historical examination of thinking. Her work must not, however, be confused with what is called the history of thought or ideas, an intellectual history. Arendt's subject is Western thinking qua thinking, not the development of ideas or knowledge.

While Heidegger, her mentor and close friend, searches in needful thought for a poetic dwelling place, Arendt dwells realistically and courageously in the historical world. Unlike Heidegger, she does not reject outright the whole tradition of metaphysics or science, but rather turns some of its methods upon the tradition itself. Arendt is no Deweyan pragmatist, however. For where Dewey makes room in his philosophy for useful truths, or what we might call a practical faith, Arendt makes room for thinking and conscience. Arendt's historical and philosophical views are concrete. She has called herself not a philosopher, but a "pearl fisher" (Young-Bruehl, 1982, p. 95), one who searches history for a little illumination of the human condition. In this role, she may well be remembered for delighting, surprising, and outraging her readers with the gems she has discovered.

Arendt intoduces her book, *The Life of the Mind* (1978), with an explanation of the motivation behind her inquiry. Her major question is the problem of evil and the relationship it bears to thinking. This question arose in her witnessing of the trial in Jerusalem of the Ger-

man war criminal Adolf Eichmann. There Arendt was struck by the fact that Eichmann never appeared to think, not even when confronted with the imminence of his own execution. Not a stupid man, he nonetheless appeared to be utterly shallow and completely thoughtless. Thus came Arendt's now famous phrase, "the banality of evil" (Arendt, 1964), and an inquiry into the relationship between thinking and evil.

As with Dewey and Heidegger, my discussion of Arendt's work serves only as a glance. Within her inquiry into thinking she offers evidence of several phenomena which I shall outline here. First, thinking and cognition are separate faculties of the mind. Cognition or knowledge depends on evidence of the senses and the common sense. Scientific enterprises may make use of thinking as a means to an end; thinking by itself, however, can never produce such knowledge. It is simply the search for meaning.

Second, the process of thinking is invisible and occupies itself with the invisible. At the same time, thinking presupposes speech which can make things of the appearing world a part of the thought world via metaphor. The metaphor is a one-way bridge from the world of appearances to the mind, and this linguistic bridge gives thought its feeling of reality. Those of us who have had the experience of "spinning our wheels" in thought can understand the sensuously real quality of the metaphor.

Third, since thinking by itself never attains knowledge, it runs in circles. (I prefer the image of the Mobius strip.) It dissolves and re-forms the concepts given in metaphorical language. All the puzzling dualisms of Western metaphysics arise out of this property of thinking.

Fourth, thought in its circular course has reflexive properties so that I may think with myself as a two-in-one engaged in soundless dialogue. This two-in-one is why I must "collect myself" and "gather my thoughts" in order to end a train of thought and present myself to the world.

Finally, the guiding experience for attaining this soundless dialogue of thought is friendship. We must speak with others in order to reflect and discover that the dialogue may continue in solitude in the process of thinking. The important points here are that the dialogue is carried on with others in friendship and that the dialogue remains friendly. This for Arendt is the source of conscience, and it can be avoided only by not thinking.

Notice that the conscience or the consciousness of dialogue is not framed in Manichean terms. It is not that struggle between good and evil that we see in a Daffy Duck cartoon where a winged and haloed duck on one shoulder argues over and against the pitchfork waving duck on the other. Nor does the conscience represent an ever-present superego with its list of commandments. The criterion of the conscience, as Arendt describes it:

> ...will not be the usual rules, recognized by multitudes and agreed upon by society, but whether I shall be able to live with myself in peace when the time has come to think about my deeds and words. Conscience is the anticipation of the fellow who awaits you if and when you come home (1978, p. 191).

In Arendt's final analysis, thinking is relevant to the problem of good and evil in that it prepares the way for judgment. And judgment is an altogether different faculty of the mind which

shows itself in the world as the ability to distinguish right from wrong and to act on that distinction.

What Arendt has done, in effect, is to create a human psychology researched in the history of philosophy from the pre-Socratics to the twentieth-century existentialists. It should be noted, however, that in this research on thinking she shows a special fondness for the philosopher who never wrote anything, Socrates. As Arendt admits, she holds Socrates up as an ideal type, someone who has a representative significance as a thinker. It may be, however, a well justified choice precisely because, while Socrates was undeniably a thinker, he neither wrote nor claimed to know much more than his own ignorance. Socrates emerges therefore as the thinker possible in everyone who speaks. With Socrates as a model, thinking does not become the property of the academy or the sciences, but a possibility for the community. Its display in the dialogue Socrates carried out with everyone he met implies thinking's communal source. That we now conceive of thinking largely in its relation to cognition shows how much we are willing to forget of our cultural history.

Toward a Thoughtful Curriculum

The scientist, the engineer, the poet, the historian, the philosopher, and not least the citizen, all seem to be capable of thinking. The question remains as to what relationship thinking bears to education. That education rests squarely on the foundation of the social sciences is an indication of the answer. But is the answer at all meaningful? Does the answer reflect a thoughtful search for the meaning of education? In any adult education classroom, for example, answers to the question of the purpose of education are likely to be several: socialization; economic progress; a personal ideology of the self. And the matter is likely to be left at that. One thing is clear: we are not engaged in dialogue, and we may not be thinking meaningfully at all. For some it may be a legitimate question to ask whether such thinking is at all relevant to the subject of education anymore. However, now that practitioners of adult education tend to regard education as the Deweyan bios, or life process, and its telos, or purpose, rather than as a preparation, the question appears to demand an answer more urgently. Socrates never said, after all, that the life not spent in continuing education or group process was not worth living.

It is not my purpose here to attempt an answer to questions so large. It is, however, my purpose to raise possibilities for dialogue. (Those who know me will recognize this as my thinly veiled argument for far more attention to history and philosophy in the field of education.) To do so, I believe that calling certain cherished notions of the progressive classroom into question is required. Among these are Dewey's thoughts on the child-centered curriculum (Dworkin, 1959). (What for purposes of this paper will be referred to as the learner-centered curriculum.)

Dewey's point in discussing the progressive learner-centered curriculum is not that all learning should be placed at the demand, whim, or desire of the learner, but that the subject must be transformed to be made relevant and useful to the learner. Dewey calls this transformation of subject matter "psychologizing" (Dworkin, 1959, pp. 104-111). The subject must be psychologized to appeal to the four-fold instincts of the human organism: communication; expression; making; inquiry. In psychologizing the subject matter, education is converted to the life process itself. This is why Dewey can suggest that education is a lifelong enterprise and not merely a matter of preparing youth. He can argue that education is the philosophy of life, and we might add that Dewey has given us life as a philosophy of education or philosophy as a life of education. And Dewey calls this transformation in education progressive.

For those of us not so privileged as Dewey to stand on the outside looking in at the progress of the human species' life processes, the questions of education appear very different. Despite the answer of a telos in human progress, we are still left with the nagging question of the meaning of goodness, truth, beauty, wisdom, justice, courage, and the ultimate question of Being. We are left with the question of whether any of these concepts can endure and resist the relentless onslaught of the human life process for its own sake. We are left with the questions of our actions. And we are still left with the question of how to prepare our youth or ourselves. Education may be one answer, but it will be education whose wagon cannot be hitched to the star of progress until progress is defined in terms other than those of education. Progressive education as an answer was only a useful truth, and it ceases to be true as soon as it ceases to be useful.

Education and the curriculum are our subjects here, and no amount of psychologizing will release us from the obligation of thinking about them with all the Socratic perplexity they propose. Nor does it seem that the knowledge of the sciences can resolve this. We are still in the position of questioning the nature of our purposes or the purpose of our natures. And to abandon the question would seem to be to abandon the educational project that requires the most thought.

In this project it would appear that questions of the meaning of education cut through Dewey's arguments on the learner-centered versus subject-centered curriculum to make a place for more basic and lasting issues. I would suggest that it is only an issue-centered curriculum that can create a place for dialogue and a conscientious thinking toward the problems and projects of education and those of any other discipline for that matter. An issue, after all, is something that matters, something in question, something in dispute. It is something with public significance that requires a decision. An issue is "the thing" (to use Heidegger's term) in the space between learners and between learners and subjects. As such the issue calls for dialogue, conscience, and above all, thinking. An issue is the complex problem that is born out of experience's story, the longing for a future, and what Arendt (1958) has termed the human condition of "plurality" (pp. 175-181). The resolution of real issues would give some real definition to the word "progress."

Ultimately, meaningful thinking takes us back to the original issue-centered place, the restless marketplace of the polis and the political life we must try to ground in friendly dialogue. This place offers neither scientific nor technological knowledge. Instead it offers the experience of otherness with all its human distinctiveness and if not knowledge, then at least acknowledgment within the delicate human fabric of memory and promise. Neither "progressive" nor "reactionary" are terms we can rightly apply to this journey back where we arrive with only what Socrates began—plus a little experience.

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AW(E)FUL THINKING

Jeremiah P. Conway

I

Halfway through an opening talk about the aims of an introductory philosophy course, an agitated hand was raised by a student in the first row. "You propose an endeavor to learn thinking. You intend this to be done here in the context of a university—standing there in front of the class, within neat one hour and fifteen minute time blocks, twice a week, by means of polite, ordered talk. This is crazy. You should be up on top of that desk, jumping up and down, screaming." My only reply was that screaming may take different forms.[1]

A university, indeed any educational endeavor, exists to instigate and sustain thinking. This is its life-giving purpose, its reason to be. Hence, it is literally a matter of life and death that a university come to grips with what it understands by "thinking." When such inquiry is dulled or ceases, education risks abandoning any real insight into what it is about and, thereby, relinquishes its only means of self-protection against becoming something which it is not, in short, a dummy, a mock-up, a pretense, a sham. Without deepening appreciation of what it means to think, institutions of learning take to going through the motions, much as the profoundly bored allow busyness to compensate for and ultimately supplant genuine activity. Unless it be very careful about thinking, education can come to earn that deadly colloquialism about pursuit of "purely academic" matters. Poets and science-fiction thrillers have given us fair warning concerning the night of the living dead. Growth in size, popular support, increases in funding, complexity of operation, proliferation of programs, services and staff, may disguise but cannot guarantee educational vitality. At its ever so fragile center, this vitality depends upon deepening appreciation of what thinking is.

Yet, it is precisely in education where the term is used so often that risk is greatest that "thinking" becomes taken for granted and thereby abused. We presume a great deal. Billions of dollars and countless hours are given over to the cultivation of "thinking" in our schools. We confidently persist in grading "thinking"; we praise and condemn, certifying failures and *summae cum laude*. We busily devise courses, curricula and programs, designed to get people to "think" and "think better." The operative assumption in all this activity is that we know what we are promoting: namely, "thinking." We assume that we have a pretty sure handle on what thinking means, even if we would be hard pressed to provide any precise definition. Another operative assumption is that further insight into what thinking means will essentially involve extending, elaborating and sharpening the conception of thinking we already presuppose. We presume to be on the right track and have merely to proceed further. In this paper, I want to examine these assumptions. I do not share the assumption that we have any clear understanding of what thinking is. Motivating this work is the suspicion that what thinking has come to mean is but a small part, far from exhausting, the nature of this activity and that this reductive sense of thinking is responsible for much that is awful in our lives and conduct. Furthermore, I suspect that deepening appreciation of what it means to think might entail radically unlearning the way thinking has been understood traditionally. I have reached the point where it is necessary to weigh the terrible words that "what is most thought-provoking in our thought-provoking time is that we are still not thinking."[2] Is

it possible to be full of ideas yet in a profound sense thoughtless? What must change in our conception of thinking if our thinking is to become less awful? Finally, I want to pursue the implication of such reflection for educational practice...for our self-conception of ourselves as teachers, for the design of courses, for conduct in the classroom.

Before proceeding, I would like to try to indicate what provoked my reflection upon this topic. It was not, first and foremost, any philosophical theory which forced the question of what is meant by thinking. With few notable exceptions, the number of modern philosophers profoundly disturbed by what thinking has come to mean is surprisingly limited. Indeed, preoccupation with philosophy more than anything else may give us the stubborn illusion that we are thinking just because we are incessantly "philosophizing." For me, the question arose quite unexpectedly out of my teaching experience, in particular, my experience of students who fail courses. As I see it, students who fail courses generally fall into two, quite distinct groups. First, there are those who are chronically unprepared for intellectual work, "students" (in this case, the term has to be used euphemistically) who come to college semi-literate, paralyzed by years of boredom and mental inactivity, profoundly uninterested, seeking only to get by and get credentialled. These I fail confidently. The second group, however, is quite another matter. There are always a few students in a class who fail not for lack of intelligence, preparation, or sincere desire to learn, but precisely because they are so possessed, indeed, exceedingly so. Why should some of the best students fail? I have compiled observations of this second group. First, they are uniformly disturbed by the "pace" of courses. Whereas other students enjoy or tolerate course "breadth" (often a polite way of saying—the frantic and fanatical rush through great amounts of material), these students instinctively rebel. They have the tendency to "mine" a text or an issue and will avoid or abandon searches which are content to remain scratching the surface. Second, these students are the least grade conscious. In quiet displays of courage, they often refuse to turn in a paper until they can be halfway satisfied with what they have written. They are open to the possibility of being paralyzed by a question or issue. Third, they come to the reading of texts and the discussion of topics with real axes to grind, with definite biases. They fight texts with such vehemence that one would think that their lives depended on it. They aren't neutral spectators and don't pretend to be. They want their studies to speak to real, immediate, lived problems in which they have a stake. Fourth and finally, their attitude towards the "rational, intellectual process" is, not infrequently, suspicious, if not downright contemptuous. Faith in reason is not something they take for granted. And, as I have come to understand, their lack of faith in reason is why they are so often fanatically dedicated to it. One is never dedicated to something in which one has complete confidence. These students puzzled me because their attitude toward "thinking" was deeply disturbing. Suffice it to say that these students pushed me to my question: why are some of the most thoughtful and sincere of students failing courses? What do my courses have to do with instigating and sustaining thinking? Well, what is "thinking" to begin with?

The first task is to try to identify the conception of thinking with which we presently operate and which we, for the most part, take for granted. I am willing to grant that there is not one univocal conception of thinking capable of encompassing what all of us understand by the term "thinking." What is possible, I think, is to identify what historically has come to be the dominant model of what we mean by thinking. That there is a dominant model or conception of thinking is a judgment which will have to be defended. Determination of this dominant conception occupies the initial part of this essay, for even if the traditional conception of thinking may have to be unlearned, it first must be recognized and clearly understood.

Let me start by way of an example. Just a few minutes ago, my attention was suddenly caught by a piece of music. For a moment I forgot what I was doing and listened. I was absorbed by the flood of sound. Then I recognized the melody and almost at the same time noticed that I had stopped working. I became conscious of listening and soon I went back to work, while the song receded into the background. The magical moment had passed.

One could give more striking examples of such an experience. We may recall how in the midst of a party we sometimes seem to step outside ourselves; suddenly we are no longer a part of the party; we have become spectators and what a moment ago seemed witty and entertaining, now appears shallow and unreal. We may still be smiling, still talking in the same manner, but our own words sound hollow, meaningless, almost as if we were not the one speaking.

But let us return to the first example. At first, I was not aware of listening to the music. I simply listened. Attention was so completely seized by the sound that the experience was marked by an extreme self-forgetfulness, an absence of self-consciousness. Only later, after naming the song, and in naming it, becoming conscious of my listening, could I say that I was listening, that there was an "I" engaged in an activity which had as its object a song. In naming the song, I singled it out and in so doing I became aware of its being just one object among others. My interest was no longer absorbed by the song alone. With this the experience changed. One aspect of this change was that I became conscious of the polar structure of the experience: that there was an "I" who was listening and that the music was an object for this subject. I certainly was not aware of this in the immediate experience. There was just the experience in its unity. Terms such as "I" and "music" were introduced only in the reflective attempt to seize the situation. But more important is another aspect. I found that once I had become aware of my listening to the music, it had lost its magic. It had ceased to speak to me. It had lost its hold. No longer was I overwhelmed by the music and moved to tears. Although I still heard it, it had become a silent object. I found that I was really listening only to myself. Upon reflection, the experience seemed to change: it seemed strangely monological.

Now, the intent of this example is to recall us to the onset, the irruption of reflection. It can be studied for a preliminary grasp of what we take thinking to involve. I recognize, of course, that trying to capture the advent of reflection is a bit like trying to seize one's shadow, in that whatever is said of pre-reflective experience is unavoidably influenced by the reflective standpoint. The pre-reflective can be likened to one's childhood: we know we had a childhood but all attempts at recalling it are from the standpoint of an adult. In considering the example it seems that reflection emerges in the event when we first become self-conscious of our experience. The first and foremost indication of this self-consciousness is the attempt to name our experience. Inherent in this act of naming is the attempt to construct a mental map of our experience. In reflection, language is used as a tool for mapping, for the re-presentation of our experience. Whether language is fundamentally a tool, whether language is first and foremost a representing of experience are questions for subsequent examination. For the time being, however, let us concentrate on the mapping entailed in reflection. The first thing to be very clear about is that no map is identical to what is mapped. There must always be a tension, a gap, between the two. Were a map to do full justice to what is mapped, the distinction between the two would collapse. A map is always an abstraction from, a highlighting and a concealing of, what is mapped. A map calls attention to certain typological features of a territory; it projects its concern with these features by identifying them and by showing how they are systematically related. Furthermore, a map is created for some use, although many maps will not always make immediately clear the particular use which governed their

articulation. For instance, certain nautical maps will indicate the various depths of a body of water. For anyone dependent upon the safety of a keel, the usefulness of the small numbers and squiggles is evident. A motorist's map of the same body of water, say a lake in northern Maine, will not bother with the same information.

A map, then, involves an always partial articulation, a highlighting and simultaneously a concealing, of certain aspects of experience. A map systematically inter-relates those territorial features it focuses upon. Furthermore, a map implicitly or explicitly is for some use. Going back to the original example, evidence of such mapping is wholly bound up with the attempt to name what it was that I was listening to. In naming what I was listening to a "song," I frame it, I situate it within a conceptual map. The concept "song," although it does not tell me a great deal, does articulate that what I was listening to was not a floating rabbit, a tree in bloom or a nightmare. Another point which is evident in the example is that the very ease with which I identified what I was listening to as "song," testifies to the fact that in reflection, in the utilization of mental maps, most of us presuppose maps which haven't been set forth by ourselves. Rather, we operate with mental maps which others have created. For the most part, we simply accept and employ mental maps which others—our parents, our teachers, our ancestors, our society and culture—have handed down to us. We are so thoroughly inculturated into the utilization of a particular mental map that the very existence of such a map is something which ordinarily escapes our notice. It is, indeed, easier to learn to forget how to ride a bicycle than to seize awareness concerning the presence of our mental map. We are habituated, perhaps the more correct word is indoctrinated, to a mental map. To have engaged in creating even the tiniest space within this mental map, to establish or transform the contours of our mental map, is a feat beyond the experience of most of us. The Greeks had a word for those who undertake their own way of conceiving the world. The word is "idiot." Our word might be "genius." The two have a lot in common.

What is generally understood as "thinking" places great emphasis upon the reflective activity of situating what we experience within the parameters of mental maps. It is the formation of ideas or mental pictures of experience which defines thinking for us. Even this determination of thinking, however, is still too general in specifying what thinking has come to mean. "Thinking" connotes not only the formation of ideas, but also a precise way of interrelating these ideas within our mental map and the ancient word to describe this relating of ideas is logic.

Logic is an extraordinarily difficult thing to define, yet it has played an enormously influential role in western culture's attempts to specify the nature of thinking. Ask most people for synonyms for thinking and the term "logical" will appear very high on the list of suggestions. The historical roots of this position go very deep. Speaking very roughly we may say that there are two very different views concerning the relation between thinking and logic, each deriving from a particular stage in the development of logical theory. The first is the Aristotelian position. Thinking, for Aristotle, was treated under the term "logic." Aristotle regarded logic as a sort of final tribunal to which all thought must submit and to which appeal can be made in order to decide what is thinking, what is rational, and what is not. Logic endeavored to articulate the permanent structures, the formal relations, underlying all thought whatsoever. Logic was understood as explication of the formal structures and rules of thought and, as such, logic assumed the mantel of the ultimate, that is, the most central and least likely to be revised, part of the systematic conceptual structure in which reality is present to us. Logic set forth the rules which govern inferential reasoning, the laws for uniting conceptual representations.

Since Aristotle, however, a second view has emerged which thoroughly contests the assuption that logic manages to capture the structure of thinking. So, for example, modern symbolic logic abandons any claim that its constructions inhere in the permanent structure of thought itself. The purpose of symbolic logic is not the determination or establishment of what constitutes right thinking, but rather the creation of formal systems of implication by means of functionally definable signs. Modern symbolic logic holds that logical method begins with axioms, postulates and transformation rules which are in no sense necessary but that, once adopted, determine strictly in advance what sign operations may or may not be performed. What is "logical," in other words, is wholly dependent upon the particular axioms, postulates and transformation rules, which happen to have been accepted. Logical method demands strict consistency but logic alone is incapable of deciding which among alternative axiomatic systems is correct or preferable. It is for this reason that a modern logician, such as Lukasiewics in his book, *Aristotle's Syllogistic From the Standpoint of Modern Formal Logic*,[3] says that the notion of formal logic as the laws of thought is a "psychologistic confusion exhibiting logic in decay."[4] Logic is not any permanent, neutral tool by which to identify what is thinking and what is not.

The inadequacy and inappropriateness of holding up logic as the measure of thinking can also be shown by examining what logic seeks to achieve and what, in consequence of its goals, it overlooks and avoids. The construction of logical systems is motivated by the recognition that the language we ordinarily employ fails to exhibit logical precision. Everyday language is, for better or worse, filled with imprecisions, ambiguities and exceptions. In the formation of logical systems, the effort is made to construct an artificial language which is better suited to the demands of formal clarity, in other words, to achieve a language in which these elements of imprecision and ambiguity are eliminated as far as is humanly possible. The task is to construct a language of exactitude.

It is important to be mindful of what is sacrified in order to achieve such exactitude. First, logic sacrifices a great deal of the temporality of language. Logical propositions tend to abstract from the time and place of the utterance, as well as the identity of the speaker. A mode of speech modeled upon the propositions of logic will avoid reference to the historical world and will gravitate toward the present tense of the timeless or tenseless assertion. Second, besides excluding temporality, logic deflects or systematically ignores other dimensions of linguistic experience; namely, the moods and stances of the Might, Ought, Should and Would. The interrogative, imperative and subjunctive are by-passed and the sole real focus of meaningfulness is restricted to the assertive mode. To be sure, there have been attempts to design modal logics, but these modal logics still cover the richness of linguistic possibility only in the crudest way. Third, from the standpoint of logic, ambiguity reflects a defect in the character of notation, an inexactitude to be remedied. For language generally, however, and for poetic language in particular, ambiguity is a fundamental constituent of meaningfulness. It functions for the sake of meaning, not in opposition to it. The depletion of linguistic ambiguity serves the goal of conceptual precision but it sacrifices the plurisignative richness of our linguistic heritage.

These comments upon logic have not tried to suggest that logic is to be rejected or discarded. It is not that logic is worthless, an impediment to thought, a 2000-year old mistake, or anything of this sort. What I have sought to undermine is the assumption that logical precision and consistency define what thinking is. Logic is an approach to thought; it is not a privileged approach or in any way the only approach to thought.

Thus far, I have tried to establish that what thinking has come to mean places great emphasis upon the dual activities of mapping and logic. These characteristics, however, are still insufficient for making clear the dominant model of thinking we tend to presuppose. Since the sixteenth and seventeenth centuries, a particular method of thinking has assumed a predominant role in modern culture. That method is known as the modern scientific method. The hegemony of modern scientific method in contemporary culture is so virtually complete that to call a way of thinking "unscientific" is tantamount to derision. The aspiration to be scientific underlies the thinking behind our technology, our public policy, the management of organizations, and, to an enormous extent, our educational system. We are very close to assuming that to think is to practice science. Hence, specification of the dominant conception of thinking today entails close examination of the distinctive character of modern science.

Hints concerning this distinctive character can be found in Galileo's claim that "the book of nature is written in the language of mathematics" or in Kant's often-quoted statement "that in any particular doctrine of nature only as much genuine science can be found as there is mathematics to be found in it."[5] Such quotes suggest that the fundamental character of modern science is rooted in the mathematizing tendency of the human mind. To characterize all of modern scientific thought as basically "mathematical" may seem, at least at first glance, a curious contention. In order to see why this is justified, we must try to grasp what is meant by the term "mathematical" and how it happens that it has become the foundation of modern scientific thought. When the term "mathematical" is used, one ordinarily associates it with something having to do with numbers. However, the meaning of the term "mathematical" cannot be taken from the science of mathematics alone because this science is only a particular form of the mathematizing power of the mind. Numbers are not identical with the mathematical; they are, rather, only the most obvious instance of it. The word "mathematical" derives from the Greek work *Ta Mathemata* which means "that which has been learned and taught." At least in its Greek derivation, then, the mathematical was not confined to the science of quantitative measurement. *Ta Mathemata* had the sense of something already learned, i.e., something known in advance. Thus, in our daily dealing with the things of our experience, before we can know plants or animals, we must first have a notion of "bodyliness"; before we can know plants or animals, we must first have a notion of "plantness" and "animalness." The mathematical is, therefore, what is known in advance of our contact with the thing. Numbers, too, are an example of the mathematical. For example, when we see three apples on the table, we recognize that there are three. But to do this we must previously have grasped what "threeness" is in order to be able to recognize that this is an instance of it. But the mathematical is not exhausted by the numerical, rather the mathematical is the known-in-advance which makes knowledge of a given thing, as that kind of thing, possible.

Now, in what sense is modern scientific thought pre-eminently mathematical? The mathematical project is a kind of ground-plan or blueprint (a map) of the structure of things which is sketched out in advance. It is a determinate projection of what the things are which are under consideration, a projection which opens up a domain, a conceptual space, in which only those things may appear and only those aspects of things which are already prefigured in the projection. In the mathematical projection there is posited in advance what things are and how they are to be evaluated. When, for example, nature is assumed to be analyzable in terms of what is already known, then sciences which make this assumption, become essentially mathematical. When instead of presupposing the need to let nature manifest itself to thought, nature is submitted to an interrogation in which the type of answer received is determined strictly in advance by the conditions laid down in the questioning to which it is subjected, the mathematical project is firmly underway. In the origins of modern science it is

precisely this mathematical determination of nature which is so evident. Nature, for modern science, is no longer an inner capacity of a body. Nature no longer is projected as having purposes, intentions, spirit, mind, etc. Nature is simply extended matter in motion. Bodies no longer have qualities beyond those projected in the mathematical projection itself. Natural bodies are nothing but what they show themselves to be within this mathematically projected realm. Their entire mode of being, their thingness as such, is determined by space and time determinations, masses and forces. Nature is grasped for the first time in history as something essentially calculable and science as that which alone furnishes the key to the resolution of its mystery.

The crux of these considerations is this: to the extent that we conceive thinking as mentally mapping and logically connecting what we experience according to the modern scientific method, we must realize that this scientific method is not merely a neutral set of procedures used to organize and clarify thought, rather, the modern scientific method presupposes that a determinate conception of what things are has already been opened up and established. Modern scientific method entails that a blueprint, a conceptual map, of what things are, has been established and accepted.

The fact that modern science operates with a mental map is nothing new; indeed the preceding pages have contended that anytime there is thinking there is reliance upon a mental map. What is revolutionary is that in the origin of modern science there occurred a fundamental alteration in the status and role of the mental map. What we see happening in the rise of modern science is not simply the emergence of a new map, but the radical assertion that this map is the foundation of all that can be known of reality. Reality becomes the picture of it projected by the map. The map has destroyed the territory by setting itself up as determinate for what is to count for being a thing. What cannot be established scientifically is not knowable. The world becomes our picture of it.

Now, before you respond to this by saying that the last point is embarassingly exaggerated, that we, especially in education, are not nearly as confident or as mentally imperialistic as has been implied and that today there exists in education a remarkable openness to a wide diversity of mental maps and a definite recognition that none of these maps, least of all that of modern science, captures reality in its picture, let me ask the following questions. How does it happen that so many either engage in or tolerate the transformation of nature into a vast pile of resources to serve the dictates of man? How do wildernesses get transformed into cultural amusement parks? How do animals by the millions get killed each year as fodder to our enormous appetites? How do our cities become each day increasingly more like one another? How do our universities increasingly exhibit a uniformity that is almost unimaginable? How is it that our businesses so often manage people into an unending treadmill of replaceable parts? How do the public policies of virtually all countries on earth come to exhibit an underlying sameness, so much so, that heated debate about alternative political systems tends to degenerate into an almost irrepressible yawn? Why the underlying uniformity? Why the overwhelming drive towards the manipulation, control and exploitation of the world about us? I have reached the conclusion that all this exists because modern culture, and pre-eminently the institutions of learning, succeed with a vengeance in promoting a definite and particular conception of what it means to think. We do teach thinking and this conception of thinking is awful. Our thinking is putting rockets on the moon, but it is also creating a world in which human survival is directly threatened. We have learned and have been taught what it means to think in the modern world. And that thinking is killing us. If we, as educators, deny our responsibility for the world we increasingly inhabit, I can only suggest that one of the most basic things which all our so-called leaders share in common is their having

passed through and, in many cases, stepped to the proverbial head of the class of our curriculums in thinking. It is a terrible judgment to render that our conception of thinking is killing us and it is important that this judgment be rendered carefully. I would be the last to deny that use of the modern scientific method has not brought about discoveries for which we should all be proud and grateful. Modern science is no Frankenstein. What is dangerous is the assumption that modern science exhausts thinking or that modern science presents us with an adequate picture of what thinking is. There is that danger that science becomes mere management or even mere business, if, in its methodical procedures, science does not keep itself open and free by continuously and originally examining its basic projection time and again, but rather leaves this projection as it were behind itself as an unquestioned given which does not require any further ascertainment, in order to focus exclusively on results and their further development and application. The very success of our thinking in producing technological miracles contributes to a familiar pattern: success breeds confidence, confidence breeds empire, empire breeds insolence and insolence leads to ruinnation. Avoiding this pattern demands questioning of the mental map of modern science and, perhaps what is more difficult, demands that we recognize and come to grips with the deep-seated emotional and spiritual motivations underlying the pursuit of our conception of thinking in the first place. Einstein once said that the disposition of the genuine scientist is most closely linked to the attitude of the religious worshipper or lover. I have come to suspect that, regardless of whether Einstein is correct, his remark is belied by the attitudes, the fundamental dispositions, evidenced in a great deal of what we call thinking. Not infrequently, the desire which motivates the pursuit of "thinking" is the desire for security. It is the desire to control, to dominate, to master, to subdue. If this judgment seems perverse, I would ask you to consider why so many of our metaphors for the activity of thinking consistently stress control, mastery and domination. We speak of "mastering a subject matter," of "being on top of an issue," of "conquering a problem," of "nailing a question down." The insistence of military metaphors for our process of thinking is not accidental. "Thinking" is practiced as a war to subjugate something to our mental map and the process feeds upon itself. Thus, there is a circular tie between the desire for control, advocating the adequacy of a map, and confinement of thinking to working within a map, fostering the dream of control. "Thinking" really is a struggle, a struggle for security and control. Hence, we speak of "defending positions," "attacking ideas," "wrestling with concepts,""devising strategies." Intellect itself is metaphorically imaged as a weapon, often a knife, which "cuts through difficulties," "slices up problems" and "carves out new fields." We want minds which are "sharp," which are "at the cutting edge," which are "incisive as all hell."

What we teach as "thinking," I would like to call: "ratiocination." Ratiocination essentially consists, as I have tried to show, in emphasizing and privileging the processes of 1) the formation of ideas (mental mapping); 2) the systematic interrelating of these ideas (logic); and 3) basic adherence to the method and framework of modern science. I would not contend that ratiocination is always taught well; my claim is that when "thinking" is taught, it is ratiocination which serves as its model. We school people in the formation and interrelation of ideas. By and large, they are not initiated to the deformation, the questioning of ideas, the imaginative generation of new ideas, the personal, emotional, emotional impulses which are necessary to the surpassing of our ideas. We practice ratiocination as if the questioning of fundamental assumptions, as if imagination and feeling, were not integral to the thinking process. We deform "thinking" by pretending that ratiocination is synonymous with it.

II

"But to tear down a factory or to revolt against a governor or to avoid repair of a motorcycle because it is a system is to attack effects rather than causes; and as long as the attack is upon effects, not change is possible. The true system,

the real system, is our present construction of systematic thought itself, rationality itself, and if a factory is torn down but the rationality which produced it is left standing, then that rationality will simply produce another factory."[6]

Before we can uphold the dual claims that ratiocination does not exhaust thinking and that the reduction of thinking to ratiocination produces awful consequence, the limitations of ratiocination thinking must be clearly appreciated. The first limitation is that no map, no matter how detailed and refined, is capable of doing justice to what is. Going back to the earliest example: to say that I was listening to music identified what occupied my attention as of a kind. It pointed out that what I was listening to shared certain features with a whole class of other particulars. Thus, when I call something "a piece of music," I am aware of the inadequacy of this name: it tells me indeed that what I heard was not a stone, nor a flower, nor an animal, but the particular ineffability of my just hearing this flow of sound is lost. Of course I may refine my language: I may say that I was listening to Mahler's Fifth Symphony, the third movement. I may try to turn to more evocative terms: that the music was a river of sadness. Yet the same inadequacy reappears. And though I can go on refining my language, finding ever more evocative attributes, I will never find a perfect name. This ultimate inadequacy of all names and concepts is rooted in the fact that they presuppose the context in which they operate; the objects are not seen as they are in themselves, but as related to things which they are not. In other words, the name or concept describes what I hear not in its individuality, its uniqueness, but in its universal aspects, as falling into a linguistic or conceptual space. But this implies that I see it as one of many possible instances of these universals. The particularity and uniqueness of the music escapes me. The ideal name, that is, the one which would do complete justice to the intended reality, is then the one which operates no longer within the context of language, a name which is beyond all languages. Only such a name, and it is evident that this implies a contradiction, could do justice to the ineffable reality which I confront. Yet although human understanding cannot know such a name, we can recognize the inadequacy of all our efforts to catch reality in the net of our concepts or names. And in doing so, we free our intuition to reach the reality, of which our understanding has fallen short. Suddenly the sound stands before us, not as an instance of some genus or species, but as just what it is. The uniqueness, the particularity of that to which I was listening to will forever escape the language of reflection. This is not a fault of language, but its very point. The danger arises only if and when reflection forgets itself, forgets its limitations.

The second limitation is this: As long as I am reflectively analyzing something by means of a mental map (whether that map be musicology, or acoustics, history, etc.), the map already presupposes, as we have said, a determination of what the things are with which the map is concerned... music as the expression of the life of its composer, or music as the formal pattern of sound through time. In other words, the map fundamentally opens up a sphere of understanding, within which things are determined as things. Reflection deals with things as objects, in other words, as grasped and fixed within the perspective opened up by the map. The problem is that the perspective or understanding opened up by the map never itself becomes an object which is capable of being studied by that map. Thus, for example, historical science may thoroughly explore a period in every possible respect and yet never explore what history is. It cannot do so scientifically. Ratiocination presupposes the nature and origin of its map. Reflection cannot study these maps themselves without ceasing in a certain sense to be scientific. Science cannot scientifically investigate the scientific method. It is an impossible boot-strap operation. Logic cannot logically prove the importance of being logical. As long as thinking is confined to ratiocination, it must remain in the dark about the nature and origin of its own maps. Another way of making this point is to say that ratiocination

is exclusively focused on that which appears as definite and definable within one's mental framework. Ratiocination concentrates on that which has been grasped as object. What escapes ratiocination is twofold: first, the questionableness of these frameworks themselves and second, the reduction of what is to what is objective. Robert Piersig puts the point this way: "at the cutting edge of time, before an object can be distinguished, there must be a kind of non-intellectual awareness. You can't be aware that you've seen a tree until AFTER you've seen the tree and between the instant of vision and instant of awareness there must be a time lag. We sometimes think of that time lag as unimportant. But there's no justification for thinking that the time lag is unimportant, none whatsoever. The past exists only in our memories, the future only in our plans. The present is our only reality. The tree that you are aware of intellectually, because of that small time lag, is always in the past and therefore is always unreal. Any intellectually conceived object is always in the past and therefore unreal. Reality is always the moment of vision BEFORE the intellectualization takes place. There is no other reality."

Ratiocination discards the presence of this pre-reflective encounter with what is as unimportant. Ratiocination leaves the pre-reflective as the wholly unthought. If thinking is to change, then return to the unthought is one of its first obligations. In short, to re-determine what thinking is, we must first determine what evokes thinking, what calls it forth, in the first place. Encounter with what is unthought, encounter with the awesome richness of pre-reflective experience, is, I think if we are honest with ourselves, what calls forth thinking.

The traditional conception of thinking is predicated upon thinking as the forming of representational ideas. The danger posed by this manner of thinking is that reality gets increasingly reduced to that which is representable. If we are not careful, the tree which is encountered blooming in the meadow is explained and accepted as, in reality, a void, thinly sprinkled with electric charges here and there that race hither and yon at enormous speeds. If thinking is to change, the thing that matters first and foremost, and finally, is not to drop the tree in bloom, but for once let it stand where it stands. If ratiocination is to be overcome as the measure of thinking, the place to start is re-examination of the disposition which lies at the heart of much of our reflection. It has been argued that the emotional disposition which lies at the heart of so much of our relection is desire for security, the desire to be in control. What seems to matter so often is managing to have the world conform to our conceptual framework. If a metamorphosis of thinking is to occur, this disposition must be radically undercut. Thinking must become predicated upon loving, not upon control. Thinking must embody that attitude of love which all the great teachers of mankind, all the way back to Plato and Christ, have insisted is the only way to salvation, which as I understand it, is the saving our ourselves and this precious earth. The project to control and the project to love seem to be distinguished in this: control seeks to have the other (be this other a thing or a person) conform to one's ideas, whereas love is being mindful of the difference. The lover respectfully inclines to the other; the seeker of control (the manager) wishes everything other to serve his inclination. The lover is marked by recognition of the other. The manager, on the other hand, succeeds when the other is most completely denied, when the other has become a factor in the process of planning, when the other has become nothing more than an extension of self.

The overcoming of ratiocination, the real possibility of a change of mind, fundamentally involves a change of heart. To begin thinking differently entails cultivation of receptivity, a heeding, a listening, an attending to what things convey to us. Receptivity, as I see it, is what is so awfully lacking in ratiocination. Receptivity demands attention not to what we already have in mind, but to the awesome presence of things, that presence to which no map does justice. The cultivation of receptivity is impossible without long preparation; it requires

schooling in the disciplines of patience, carefulness, devotion, attention to detail, peace of mind, and unhurriedness. It seems to me that the goal of receptivity is to inculcate the capacity to be immersed in things. Receptivity happens when we are bowled over by the splendor of the simple. Only when we are really immersed in what is to be thought, can we reveal the wonder of anything, no matter how commonplace. Only then can we avoid our habitual ways of grasping something as it is for us—subjectively.

The alternative to ratiocination, or what I would call meditative thinking, is quite literally and fundamentally the event of responsibility: the ability to respond. In contrast to ratiocination which reflects upon things as they are grasped within a conceptual framework, meditative thinking is pervaded and sustained by the encounter with the presence of things before this presence has been made conceptually articulate. The contrast is between a thinking *about* things and a thinking *towards* things. The former presupposes that the things about which it thinks are already grasped, the latter is rooted in the recognition that what things are, the being of things, is always what remains unthought. Meditative thinking is responsibility to what is unthought. The more original this thinking, the richer will be what is unthought in it.

It might seem that the proper name for this realization of the unthought is sheer stupidity. But this would be a mistake. It presupposes the perspective of ratiocination within which the undefined is the unimportant. Meditative thinking's appeal to what has not been thought can be dismissed only by taking for granted the adequacy of our conceptual framework. Indeed, one of the key impulses of meditative thinking is to make possible greater openness of thought by subjecting conceptual frameworks to critical questioning. Willingness of thought to undergo critical self-scrutiny, willingness to try to identify and examine the most basic presuppositions of our mental map, is intimately a part of meditative thinking's cultivation of receptivity. Without critical questioning of our most basic presuppositions, we cannot hold ourselves open to the presence of things; instead things are snapped up into the framework of our thought without the slightest sense of the violence and concealment taking place in the articulation. It is for this reason, this constant suspiciousness of—one could almost say, atonement for—our ideas, that meditative thinking is capable of so little progress. Meditative thinking is incomparably poorer in what it has to offer, if compared to ratiocination. Meditative thinking, rather than giving, is centrally an activity which takes away: takes away our self-assurity, takes away our self-confidence, takes away the presumption to control. In meditative thinking we become learned concerning our ignorance. Another way of putting this is that the very light within which we see and conceive things meditative thinking puts into question. It refuses us the possibility of taking this light for granted. The spheres of reflection within which we investigate things come themselves to examination. The essence of these spheres—history, science, art, religion, etc., is the concern of meditative thinking. Meditative thinking is reflection which refuses to take the reflective standpoint for granted.

The curious title of this essay seeks to indicate the change of thinking which, I am convinced, so desperately needs to take place in education. I have argued that if thinking is to become less awful, what must occur is the cultivation of responsibility, literally, the ability to respond to the presence of what is and its incredible mystery. Another way of saying this is that the possibility of meditative thinking depends upon the maintenance of awe, the sustaining of wonder—which, as I see it, is that state in which thinking is most receptive. Awful thinking must become aweful thinking. There is nothing new is this realization. Already Plato and Aristotle had called attention to the vital importance of wonder as the state of attunement to the being of things in which thinking is evoked. "For this is particularly the PATHOS

of a philosopher, to be immersed in wonder, for there is no other beginning of philosophy than this." The word "beginning" (*Arche*) means here not only the starting point, but also that which governs, carries and pervades the entire movement of philosophical thought. Aristotle said the same thing in the *Metaphysics A,2:* "Through wonder men have reached now as well as at first the determining path of philosophizing."

III

> *"It was late afternoon and our long conversation about education was drawing to a close. As he was leaving, the student stopped at the door and said he wanted to leave me with a true story. 'For quite some time I worked as a merchant seaman out of the South American port of Valpariso, Chile. On leave, I used to visit a bar in the dockside area. A very rough spot, so rough you would have trouble imagining. At night the police would cruise around the bars in order to carry out the casualties of the fights. Well, one night while I was at this bar, a young man jumped up on top of a table and announced that he had just composed a poem. The whole uproarious room fell immediately and completely silent. People hung on every word. After the poem, comments began, criticisms were made, applause given, until the fighting broke out once again. I tell you this story because in all my schooling I never witnessed that rapt silence in a classroom. Can you tell me why? Are we unprepared for the urgency of listening? Or have we come to expect that so little is really being said?"* [7]

In the final section of this paper, I want to trace out some of the practical implications of this change of thinking for educational conduct. The first implication is need for a fundamental re-examination of what is meant by teaching. As long as meditative thinking is not grasped as essential, then the teacher can be considered a dispenser of knowledge, a manager of information, a disciplinarian. All functions, it should be noted, which increasingly can be performed by clever machines. But if thinking be meditative, then the teacher is the irrevocable learner, not merely a fellow learner, but the learner *par excellence*. Teaching is even more difficult than learning, because what teaching calls for is this: to let learn. The teacher is ahead of students in this alone: that he/she has still far more to learn than they—he/she has to learn to let them learn. The teacher, therefore, is far less assured of his/her ground than those who learn are of theirs. Hence, if the relation between the teacher and taught is genuine, there is never any place in it for the authority of the know-it-all or the authoritative sway of the official. For the teacher is marked by reverence for the questionable; the inclination to teach is the bent, not towards what has been said and clarified, but towards what remains unspoken and concealed. The teacher, as irrevocable learner, is, above all, mindful of what has withdrawn, what has been left out, what has been overlooked and unheard, in all the talk. Indeed, the gift of teaching is ability to recall oneself and others to memory of the unthought. This is but another way of saying: the teacher is the provocateur of wonder. Mindfulness of what is unthought, unapparent, is what calls thinking forth in the first place. The one supreme obligation of the teacher is to be a brilliant midwife, delivering us to wonder.

From this understanding of teaching a number of suggestions can be drawn concerning how such teaching is put into practice. These suggestions, I believe, run counter to general pedagogical conduct. My list does not pretend to be complete and my effort to formulate them into somewhat pithy maxims is motivated only by the desire to stake out a few signposts and not to contribute to the illusion that learning any set of maxims can a teacher make.

1) THE SUBORDINATION OF TEACHING TO LEARNING. The last thing a student is prepared for is teaching in the sense previously discussed. Students are used to being given maps, expected to learn maps and repeat these maps when called upon. If they have been in education long enough, students instinctively look to the funny creature at the head of the class to provide such maps. Students expect that teachers know more and are habituated to classes largely occupied with teachers trying to demonstrate this fact abundantly. Not only is this the expectation of students, but, on the part of educators, this is often a very seductive, gratifying role to perform, to which they are only too willing to accede. The role of the knowledgeable expert provides enormous amount of ego-satisfaction. In the vast majority of classes, the teacher is literally and figuratively the center of all attention and constantly looked up to. In my own experience as a teacher, I know that for quite some years what I was essentially doing in the classroom was proving myself, showing to a receptive audience (or at least an audience well schooled in disguising boredom) that I richly deserved the position of being listened to constantly. Their test was to see if they could show me that they had learned what I had learned. Schools teach one to imitate. In college, it is slightly more sophisticated: one is supposed to imitate the teacher in such a way as to convince the teacher that one isn't imitating.

A teacher matures, I hold, essentially with the realization that one is not in the classroom for oneself. Proving one's brilliance in the eyes of students only too willing to be dazzled by others' brilliance is but a crude form of self-absorption and aggrandizement. This insight is useless unless it ripples into some of the deadly truisms, the conventional baggage, concerning how to teach effectively. I had been schooled, for example, to the idea that course planning is one of the essential keys to good teaching. Surely, there is a sense in which this is correct, if by "planning" is meant intense involvement in the questions raised by a course, intense imaginative effort to situate ourselves in the position of students first encountering such questions and great care in the manner in which questions are unfolded. Unfortunately, course planning is often conceived quite differently from this and amounts, instead, to the formation of a highly articulate syllabus and the extremely detailed elaboration of how this syllabus will be executed. In other words, course planning becomes synonymous with the imposition of a very rigid, pre-determined framework. One of the hardest lessons for me to learn has been the abandonment of planning in the current sense makes for better learning. Course-planning, as we commit it, is a sure-fire device for foreclosing any element of surprise, steadfastly avoiding the possibility of anything emerging in the classroom which is uncalculated or not in the prepared text. It is part and parcel of the project of control and teaches students an unforgettable pedagogical lesson: that they must learn to be obedient. Education, as we know it, is organized by discipline in all senses of the term, not the least of which is training to obey.

2) THE AWAKENING OF CARE. Whatever the ostensible title and subject matter of a course, the real, hidden educational agenda should always be the same: the learning of thinking. Yet no one starts out caring about thinking *per se*. Rather, care emerges out of very concrete, personal concern with particular things. I start caring about why the mugo pine in the backyard is wilting, or why my son is frustrated with his forehand volley, or why Kafka excises these particular words from his novel. To come to care about thinking, the issue of thinking must first engage in the context of caring about some very definite, usually personal, things.

Of paramount importance, then, is that education operate from the insight that the first and primary teaching task is to get students to OWN a problem. Whatever the problem, it must

be thoroughly appropriated. Owning problems means not only that problems must be quite definite and specific, but also that the problems be presented such that students are provoked into personal response. The "academic" versus "non-academic" distinction must begin to collapse. Whereas students' non-academic life is a felt life and their academic life is feeling deprived, this dualism between living and thinking must be undermined. In the problems they are asked to face, students must have the problems take life within them. In the problems they must come to have a stake. The observant teacher knows precisely when the problem has hit home: voices take on intensity, bodies hunch forward, laughter comes close to tears, hands stop getting raised and impromptu harangues begin, desks start getting thoroughly deranged. Care is the key. If one comes to care about a particular problem, then one inevitably will care about the thinking with which the problem is addressed. Now, I admit that care is not something which can be imparted or conveyed into another. The most that is possible is that problems are posed such that the opportunity to care is utterly available. Students learn to care more deeply in witnessing the care of the teacher.

This essay has tried to raise the question of what is meant by thinking. In the guise of a conclusion, let me say this. This essay has tried to highlight the importance of our way of thinking and the need to question the way of thinking predominantly emphasized in educational practice. If a way of thinking has such power, then its danger, its threat, to us is evident. Political propagandists and advertisers have realized the connection between thinking and control far more acutely than many of us. Control the way in which people think and you control their lives. The submission of people requires no great armies or police; submission is far more effectively brought about through the subtle maintenance of a way of thinking. The best strategy to get people into jail is to structure their thinking so they are convinced there aren't any jails. Give people their ideas and they are yours. Whereas physical coercion is easily recognizable and, therefore, can incite opposition and protest, the violence of a way of conceiving things is hardly noticeable. One implication of this insight is the extent to which enormously destructive actions and policies can be unintentional, fostered not by a desire to hurt but by unquestioned acceptance of the way of thinking churning out these actions and policies. In other words, the manipulation of people through disciplining their way of thinking may not even be malicious and this is more dangerous and disturbing than willful criminality. The worst manipulation takes place when the manipulation goes unrecognized both by the manipulator and the manipulated. Hannah Arendt, in her book, *Eichmann in Jerusalem*, developed this theme of the banality of evil. My essay has addressed the same theme from the other side; namely, the evil of banality, where banality fundamentally involves complacency about what it means to think.

We can be held captive by a way of thinking...a theme as old as Plato's myth of the cave. We recognize this possibility when, in colloquial language, we speak of "tunnel vision" or "the one-track mind." Tunnel vision is easiest to recognize and criticize in others; it is extremely difficult to recognize in oneself. But when a way of thinking has become collective, the questioning of the obvious seems an idiotic enterprise. In a world where ratiocination has a powerful upperhand, thinking rooted in wonder is not only an awesome responsibility, but a dreadfully frightening experience. To open students to the possibility of awe in a world terribly busy in oppressing such thought, to nourish the possibility of our responding to the world, is one of the ways in which screaming may take different forms.

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This paper was also presented at a special symposium of the USM Philosophy Majors Association, where it received comments from three philosophy students, Mark Alhstrom, Mary MacLean and Frank Turek. For their very helpful suggestions, I would like to express my thanks.

Part III:
Applications

TEACHING SCIENCE AS A MODE OF THINKING

Gale Rhodes
Robert Schaible

The most difficult concept in science is science itself. The most challenging task of instruction is to depict science as a dynamic process rather than a static body of knowledge. Those who teach science or other disciplines that treat science's history, sociology, or philosophy can greatly enhance student understanding of this process and of scientific thinking if they make careful use of three terms that scientists use frequently, but often too carelessly. These three terms are **fact** (or **datum,** the result of an observation or measurement), **law** (a description of a pattern or trend in the facts), and **theory** (an attempt to explain why the laws hold). Each term, when used as defined here, illuminates a specific aspect of scientific thinking. By using these terms thoughtfully in categorizing different aspects of scientific knowledge, the teacher can depict science as a form of thinking that gradually leads to a more coherent, consistent, and comprehensive picture of nature. Such an approach can help the student to understand why scientific truth changes or evolves.

In this paper, we will define these three terms thoroughly, discuss the aspects of scientific thought that they illuminate, and give examples of them in widely taught scientific concepts. We will also suggest that the types of thinking revealed in scientific facts, laws, and theories have at least rough parallels in literature, and that consideration of these parallels can be useful to students taking courses in both science and literature and seeing no significant connections between them.

If you treat science in any facet of your own teaching, we encourage you to consider the advantages of defining and using these terms as we suggest; if you use these terms consistently, as defined here, you will be guiding your students toward a better understanding of scientific thought, of the **process** that makes a unity of the contradictions between what you taught last year and what you teach this year. In addition, an appreciation of the parallels we will draw might also, by revealing a kinship between scientific and literary thinking, help to alter a common misconception of science: that it is a source of absolute, unquestionable truth. Our view emphasizes that scientific, like literary, knowledge is not absolute, that both fields are human activities, carried out by fallible men and women facing inscrutable reality.

First, **fact.** A fact, or a datum, is the result of a measurement or observation. If we measure the pressure of a certain mass of a gas, like air, and record our reading of the pressure gauge, it is then a **fact** that this gas, under the specified conditions, exerts such-and-such a pressure (Figure 1). Theories possess two aspects that are too often overlooked. One is that each fact, to be complete, must include a detailed description of how it was obtained, or more to the point, how it could be obtained again—checked, that is. So the conditions of the measurement, including all factors—the temperature, for instance—that are known to affect the result, must be included if we are to know the fact completely. The second aspect, crucial to our understanding of the fact, is a statement of its uncertainty: just how accurately, or to what precision, do we know it. An engineer would call it the tolerance in the measurement. "The pressure is 12.7 pounds per square inch, plus or minus 1.1 pounds." Every scientific fact wears this halo of uncertainty about it, and we simply do not know what we know if the extent of this tolerance is concealed from us.

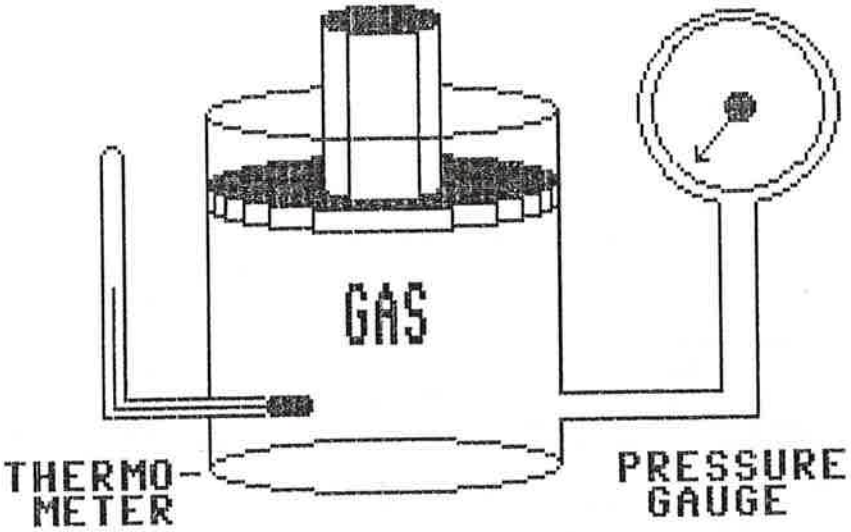


Figure 1

So a fact results from measurement or observation, and it is not complete until we say how, and how precisely, we measured. To understand the nature of fact is to understand an important aspect of scientific thought, to which all scientific thought, whether it arises in an orderly fashion from fact or not, is intimately anchored.

Scientists, and any careful observers, collect facts all the time. But there is a human inclination to do more than just record and remember them. We tend to notice, perhaps even to look actively for, patterns or trends in the facts. A description of such a pattern is called a **law.** A law says that the facts fall out a certain way, or follow some trend. We may note, in collecting facts about gases, that the pressure of a gas like air consistently increases if we decrease its volume, say by enclosing it in a cylinder and pressing a piston on it (Figure 2). In looking more carefully at the facts of this matter, we would see an even more striking trend. Halving the volume doubles the pressure; reducing the volume to one-third triples the pressure, to one-tenth increases the pressure tenfold (Figure 3). A description of this trend, "multiplying the pressure of the gas by its volume always gives the same result, or

$$PxV=k,"$$

(in which k represents an unvarying quantity) is an example of a **law.**

There are two aspects of this law, and all laws, that are too often forgotten. First, the law is no more reliable than the facts in which we see it. If the halo of uncertainty in the facts is large, the patterns we see may be illusory. More careful measurements may reveal that the facts do not fit the proposed law at all. Second, a law, to be complete, must include a statement of its range, or its reach. We might find that this law holds as long as the pressure is low enough, and as long as the temperature is high enough, that the gas does not begin to turn to liquid. We might find that this law holds as long as the pressure is high enough, and as long as the temperature is low enough, that the gas does not begin to undergo a chemical

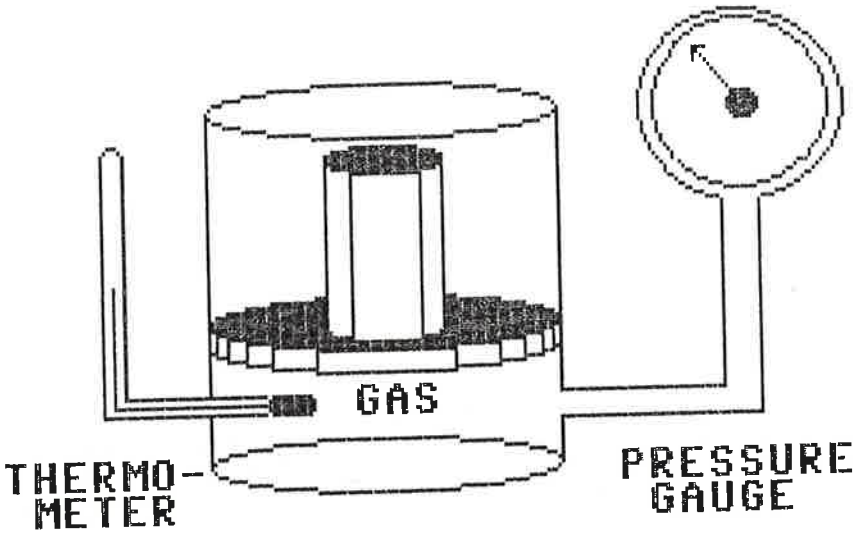
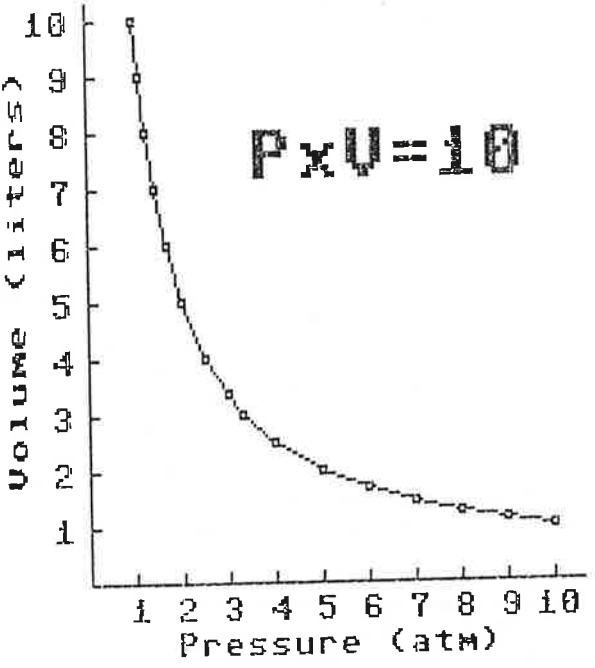


Figure 2

P	V
1	10.0
2	5.0
3	3.3
4	2.5
5	2.0
6	1.7
7	1.4
8	1.2
9	1.1
10	1.0

Figure 3



change. An essential part of every scientific law is a statement of its range of applicability, and we simply do not know what we know if the range of our law is concealed from us. We seek laws that reach as far as possible, but as always in science, we'll take whatever we can get, for laws are enormously useful and practical. They let us predict. If we want to design a tank to hold a gas, we can use this law to help us design the tank so that it will not burst when a certain volume of gas is squeezed into the smaller volume of the tank, the pressure of the gas, predictably, increasing.

So a law describes a trend or pattern in the facts, often in the form of an equation. The simple recognition of such a pattern is useful; with this knowledge, we can know the results of experiments untried, and we can recognize some of the potential for danger in a new design. To understand the nature of scientific law is to understand an important aspect of scientific thinking, to which much of science's predictive power is harnessed.

While we are using the laws to gauge our expectations, we tend, as we do with facts, to look beyond them, this time asking, "Why? Why do the laws hold?" For a few centuries now, we have assumed that such queries are answered by descriptions of underlying or prior conditions. When we ask why the gas pressure increases as we decrease the gas volume, we are asking for a **theory.** A theory is an attempt to explain why the laws hold, why the facts fall out in some sort of orderly way. In effect, we are asking, "How does this behavior illuminate the underlying nature of the gas?" or "What is a gas, that it should increase its pressure when we decrease its volume?"

There are two aspects of theories that are too often forgotten. First, the answer, the theory, will be tentative, for we are asking how the unseen gives rise to the seen. Second, to be useful, that is, to advance our understanding, the theory must be testable: we must be able to look for the entities or effects we use to explain the laws. Otherwise, we have no basis for developing any confidence that our explanation is reasonable.

The most successful theory of gas behavior asserts that a gas is composed of many tiny particles moving at great speeds, colliding with perfect elasticity with each other and with the walls of their container. In this view, the pressure that causes the gauge to show its reading, or the pressure that stretches the skin of a balloon, is the constant rat-a-tat of these particles against the barrier that encloses them. If the volume of the container is decreased, these particles will strike the walls (and the pressure detector) more frequently, and thus exert a higher pressure (Figure 4). This theory provides an explanation for the gas's lawful behavior.

Scientists did not spring immediately for the nonintuitive notion that these collisions should be perfectly elastic; after all, we do not see this perfection is everyday collisions. But the gas pressure persists, so the particles are not gradually running down. The idea that the collisions are elastic is forced on us by the facts and laws. Each element of the theory is necessary. We want to explain as much as possible in as few words—so to speak; actually with as few assumptions, as few hypothesized entities and effects—as possible, and we want to be able to test those assumptions. The goal here is understanding, which can give us greater predictive power than we can get from laws. From laws we can predict facts, but from theories, we can predict laws: we can anticipate patterns or trends we have not yet recognized in the facts. If we find these patterns, we look upon our theory with increased confidence.

So the theorist attempts to deepen her or his understanding of nature by formulating a mechanism that explains why nature behaves the way it does. A good explanation is one that postulates underlying entities or effects that we can actively seek in order to see if the explanation is valid. The theorist's ultimate quesion is "What is reality that we should find

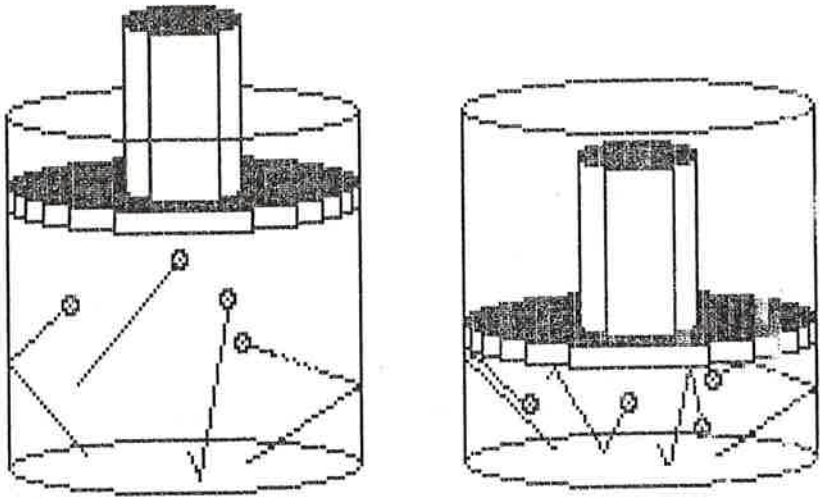


Figure 4

these consistencies (laws) in it?" The authors believe that our only basis for confidence in the answers to these questions lies in the coherence, consistency, and comprehensiveness of the edifice built of our facts, laws, and theories. There are no answers in the back of the book of nature. When we search nature scientifically, we do not reveal naked reality, any more than when we search our souls for the answer to a moral question. In both cases, all we can do is ask whether the answer seems fitting. To understand the nature of theory is to understand an important aspect of scientific thinking, one that more than any other reveals the nature and the limitations of this powerful but human mode of inquiry.

You should note that each of these elements of science has its own logical form. A fact says that a measurement, made in a specified manner, and with a specified precision, gives a particular result. A law is a description of a trend or pattern in the facts. A theory is an attempt to explain why the laws hold. A result of measurement, a description of a pattern, an explanation of the pattern's cause; each has a different structure, so they are not interchangeable. A law does not become a fact, no matter what its range or precision. A theory does not become a law or a fact, no matter how great our confidence in its explanatory power. Even if in some manner we could prove the theory correct, if we could demonstrate that our explanation is valid, it is still not, by the definitions used here, a fact. A theory possesses a different kind of logical structure than does a fact. We might say that whether a scientific statement is a fact, law, or theory depends as much on its form as on its content.

We promised to use these matters to draw some approximate parallels between the activities of science and literature. Our comments here are meant to be suggestive only, and to help students find bridges between what must seem completely disparate activities. Our search for parallels, therefore, focuses not on the rigors of recent literary theory or the philosophy of science, but rather on the more available matters that might draw students to science and literature in the first place: to science, a desire to understand nature and their place in it;

to literature, a desire to understand themselves and their relationship to others and to the wider cosmos.

Consider the scientist's search for explanations. There must be some parallel search that we all make when approaching a work of literature, a work that is, in the widest point of view, as much a part of nature as are the spider's web and the beaver's dam. Taking the terms precisely as we have defined them, let us use Walt Whitman's poem, *Song of Myself,* to illustrate the parallels (See Whitman, 1959).

We would say that the primary facts of the poem are the individual words; the groups of words forming distinct images, perceptions, and ideas; and the sounds and rhythms produced by these words. Thus, the first word in the poem, "I," is a fact of the poem. The first complete idea expressed, "I celebrate myself," is equally a fact of the poem. From section 2, such phrases as "the smoke of my own breath," "the sniff of green leaves and dry leaves," and "the feeling of health," among many others, are also facts. The reader, then, is faced first with these particular entities, the facts of the matter. He observes and takes the measure of these facts with the instruments of eyes, ears, and mind.

If called upon to provide a detailed description of how each fact was discerned, the reader would have to explain the definitions and implications of each word, the grammatical and syntactic relationships within each significant word group, and the influence of his own experience on the words and ideas before him. So any fact of literature, like any fact of science, wears a halo of uncertainty simply because every substantive word has more than one definition, each of which has its complement of implications, and the complete measuring of each fact must take into consideration the influence of neighboring facts and the reader's experience. Such halos notwithstanding, the reader can establish, with reasonable precision, the facts of the poem.

Simply observing the facts, however, is usually no more satisfying in literature than it is in science. The reader will try to make sense of the poem, to find trends or patterns among the numerous verbal and sensory facts. In short, the perceptive reader will seek an **interpretation** of the poem; and this interpretation is, in our view, law-like. Without such an interpretation, which must span the whole work, the isolated facts of *Song of Myself* do not cohere; indeed, many of them clash with each other in a chaos of contradictions. For instance, Whitman's uses of the words "I" and "self" seem at first quite puzzling. Students often say that the poet must be disgustingly arrogant to "celebrate and sing" himself with such assertions as

> ...I am silent, and go bathe and admire myself. (Section 3)
>
> ...I find no sweeter fat than sticks to my own bones. (20)
>
> Divine am I inside and out...(24)
>
> If I worship one thing more than another it shall be the spread of my own body or any part of it...(24)
>
> I dote on myself, there is that lot of me and all so luscious...(24)
>
> ...And nothing, not God, is greater to one than one's self is...(48)
>
> ...Nor do I understand who there can be more wonderful than myself. (48)

But students frequently find other passages that are inconsistent with this notion of an egotistical poet:

What is commonest, cheapest, nearest, easiest, is Me...(14)
I am...a learner with the simplest,..., A novice...(16)
Whoever degrades another degrades me...(24)
...I project my hat, sit shame-faced, and beg. (37)
...If you want me again look for me under your boot-soles. (52)

These two sets of literary facts seem contradictory, but the contradiction can be resolved if "I" and "self" are interpreted to mean something larger, something broader, than the personal self. If the reader determines that the self of the poem means a universal Self in which all matter and mind partake, then these contradictory passages cohere, and the reader moves toward a consistent interpretation of the poem. Because developing this interpretation means finding a pattern in the facts (words, images, and so forth) of the poem, its discovery is at least somewhat like the discovery of a law. The reader checks the interpretation for consistency and range, just as the scientist checks the law, before he or she is content with it. For example, the reader who focuses initially on the top set of quotations above might well form an interpretation that the poem celebrates the sort of ego-centered hero that intellectually aspiring sophomores applauded in the 1960's in the popular novels of Ayn Rand. As our hypothetical reader tests this interpretation against other facts in the poem, however, he or she will soon discover its limitations and be forced to revise it in order to make it compatible with the wider range of facts. The reader is then able to approach a new and difficult passage with a measure of predictive power, with confidence that the new facts will conform in some manner to the established interpretation.

If the interpretation of the poem is in some respects parallel to a law, what is left in literature to equate with theory in science? In science the theory reflects our quest to understand nature. In approaching literature, we seek a more personal understanding: of ourselves in relation to others as well as to the cosmos that houses us. In science, the theory is an attempt to answer the question, "What is reality that the laws should hold?" In literature, we may state the question this way: "What is human reality that our interpretation of this poem should (or should not) illuminate that reality and thus seem fitting to us?" It is our theory of this human reality which determines whether the poem moves us and seems valid and fitting. If, for example, our theory of reality is one of radical materialism or radical behaviourism, we will most likely be unmoved by the vision we find in Whitman's poem. If, on the other hand, our theory of reality includes the possibility of a transcedent unity—individual to individual, non-life to life, life to mind, mind to something greater, then we find that the poem is fitting, that its fact and laws square with our understanding of human reality. In either case, just as the scientist checks his theory against the data, we test our understanding (theory) of human reality against the facts and laws of the poem, looking for coherence, consistency, and comprehensiveness. When we do not find these attributes, we either reject the poem and turn to another set of facts (another poem) amenable to a different interpretation; or, if the poem is compelling enough, we reconsider and perhaps modify our theory; that is, we revise our understanding of the human world in the face of literature that is sufficiently compelling.

We believe that an important element in the human search is the quest for understanding. In the natural world, we ask, "What is reality that nature's laws should hold?" More personally, but still scientifically, we ask, "**What** am I, that nature's laws should apply to me?" In literature, we ask instead, "What is human reality?" or "**Who** am I, that experience, including the experience of literature, moves me as it does?"

To summarize: the scientific fact has at least a rough parallel in the physical work, the printed symbols, of literature; the law, a rough parallel in an interpretation of the literary work; the

theory, a rough parallel in the reader's vision of why the work is fitting in the light of human experience. All the activity of the human intellect grows out of the same organ, the brain, and its interaction with the world. We serve students well if we suggest to them that there must therefore be deep and interesting parallels that span even the widest gaps of our knowledge, and that reveal the wholeness of humanity's collective vision.

We conclude with another examination of logical form, this time the form or construction of these questions that theory purports to answer. We did not first find this formulation in science, but rather in quite well-known and beautiful literature, and it seems quite naturally to fit science also. The form is that of the Psalmist's question (Psalm 8:4), "What is man, that Thou are mindful of him?" The Psalmist (probably David) believes, on evidence from the particulars and trends (facts and laws) of his own life, that his God is aware of us; in fact he goes on the assert (an assertion at which today's environmentalists blanch) that God has set us just below the angels, and given in dominion over all the earth. To the Psalmist, the facts of life cohere in the patterns of his God's intervention. But then the Psalmist, no doubt a theorist, compares humanity with all the seemingly more spectacular wonders of God's heavens, and muses, "What do these signs, implying that God is mindful of me, tell me about myself?" or "Who am I that God should care?" Whether we believe as the Psalmist does or not, we cannot miss here that the Psalmist is inviting us to seek an explanation for life's patterns, to theorize, and thereby to enter into the powerful mode of thought through which science commands nature, and we command our own lives.

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CRITICAL THINKING AND THE REAL WORLDS: THE USM SUMMER INSTITUTE EXPERIENCE

Slawomir Grzelkowski
Mark Hineline

I. Introduction—Teaching and Learning of Critical Thinking

In recent years, a flurry of national reports has described an apparent malaise in the American system of public education. Apropos of these reports, declining levels of students' abilities to "think critically" have been identified as a dominant manifestation of a larger crisis of mediocrity in education. The result, notes an expert in the field, is that "probably never before in the history of educational practice has there been a greater push to teach children to think critically," (Sternberg, 1985a p. 194). In this paper we discuss the design, implementation, and evaluation of an educational activity which might be interpreted as an entry in the aforementioned "push" to teach critical thinking. We say "interpreted" because the activity was not specifically conceived in this way.

Although the design for the activity is borrowed directly from the literature on critical thinking—specifically, Robert Sternberg's (1985a) "Critical Thinking—Are We Making Critical Mistakes?"—and while, in hindsight, we recognized several affinities with other critical thinking programs, the Technology Assessment Activity (TAA) discussed in this paper received its single trial not as an attempt to "teach" critical thinking, but rather as an effort to weave together the loose ends of a successful but didactic interdisciplinary course entitled "Technology and Culture." The significance of the difference between intention and result will be drawn out in our conclusions.

Over a period of three years, "Technology and Culture" evolved from its beginning as a "standard" core curriculum course at the University of Southern Maine (originally "Man, Society, and Technology") and culminated in two offerings for the Summer Humanities Institute for Gifted and Talented High School Students, in 1985 and 1986. In its regular academic setting, the course was taught by a team consisting of John Zaner (Department of Industrial Education and Technology), Judith Drew (School of Nursing) and one of the authors (Slawomir Grzelkowski, Department of Sociology). A fourth member of the original faculty, Jack Hanna (Department of English), retired at the end of the first semester of the course.

From the beginning, the faculty made some important decisions regarding the nature of materials to be used in the course: the three themes of communications, mass production, and bio-technology were selected as most suitable to interdisciplinary discourse on the social and cultural context of technology. Some vague need for an experiential activity on the part of the students, which would break the routines of the lecture/presentation course and allow for greater student involvement, was also recognized. The teaching team struck upon the notion of class activities allowing student projects and analytic papers having to do with advertising as a form of communication, and development of an "art" piece expressing their ideas and affective complexes regarding mass production and its impact on society. The interdisciplinary nature of the course and its teaching team virtually assured that it would continue to remain functionally inchoate from semester to semester. As a result, the team welcomed an invitation to modify the semester format for the Summer Institute in 1985.

This development necessitated some major changes, some of which were in the nature of personnel. One of them involved including on the faculty team a British scholar, Professor

Perry, who was a specialist in design. Another included the hiring of Mark Hineline whose role ranged from academic functions to "camp counseling" of the students-in-residence. In planning the first summer's program, it became readily apparent that the focused format for the Institute allowed and even demanded greater student involvement in the intellectual content of the program. Field trips, several hands-on activities and various forms of role-playing were built into the program. These activities met with varying degrees of involvement and success, but still did not provide a vehicle for a more-integrated, synthesizing activity of longer duration, which would cut across all of the academic units of the Institute and provide its experiential focus. Therefore, in preparation for the 1986 Institute, we began to search for a more meaningful activity which would not only provide for greater involvement on the part of students, but would also challenge their critical abilities as future decision-makers coping with real-life problems of technological civilization.

A paraphrase of Robert Sternberg's ideas (Sternberg, 1985a), provided by a quick skim of the article several months before, aided in the process of search, but only in a general sense; the importance of it all was driven home later. Sternberg has suggested (and we agree), that programs designed to teach critical thinking often lack necessary rational assessment of their limitations or liabilities. Among these limitations and liabilities is the tendency to design programs that teach "critical thinking" through problem solving activities that are divorced from real life problems and life experiences and from the aspirations of students, both in their roles as students and as incipient adults. Sternberg has drawn up the following ten-point indictment of "academic" problems, as opposed to their real-life counterparts: (1) recognition that a problem exists is a large part of its solution; (2) it is often harder to figure out what the problem is than to find its solution; (3) everyday problems tend to be ill-structured; (4) the nature and sources of information are usually unclear; (5) real life problems are contextual, not isolated; (6) no one right solution or best solution might exist; (7) informal, tacit knowledge is often as important as formal knowledge; (8) everyday problems have consequences that matter; (9) everyday problems must often be considered in group rather than individual contexts; (10) such problems can be complicated, messy and persistent.

We emphasize that our use of Sternberg's descriptive criteria of "real-world" problems reflected our need to allow the students in the 1986 Institute to synthesize their learning in a way that the students of 1985 did not. We did not set out to create a "critical thinking" program.

II. The Design and Implementation of the "Technology Assessment Activity"

As a model for TAA, we chose early on to reconstruct a legislative process. In response to Sternberg's critique, we eschewed the "civics class" approach to legislative activity, preferring the more open-textured roles of legislators, lobbyists, reporters, and editorial pundits to the simpler and more cleanly available roles of legislators acting acontextually. More important, we chose to leave the matter of problem selection entirely in the students' hands, requiring only that the problems chosen reflect some technological aspect of modern society. Below is a schematic account of the activity and its requirements.

Eight students were selected by their peers to serve as legislators. These students were asked to research and draft four bills, with input from the balance of the Institute participants. Students were provided with an orientation to the university's library and were expected to develop a "browsing familiarity" with current editorials, letters to the editor, news and notes sections, and general articles in scientific and technical journals. Although these early phases of TAA took place in something of an information vacuum, a glimpse of the construction

of the activity was provided through discussion of a case study of the U.S. Army Corps of Engineers' Garrison Dam Project and its effect on three viable Indian cultures. Through this discussion, the roles of constituencies were explored.

Every student was required to produce a minimum of two pages of written work, which was to be duplicated and a copy made available to every student and faculty member. Reporters followed general journalistic style in a "newsroom" environment, created in computer lab. Lobbyists combined newly gained technical expertise with persuasive techniques. Legislators produced bills in draft form; and editorialists had free reign to express opinions in an effort to influence the decision making process.

A state legislator known for his charismatic style and experience as a lobbyist delivered a talk on the legislative and lobbying processes, which served as an antidote to the standard "civics class" presentation of democratic processes. Two issues were stressed in his talk: the importance of problem articulation ("framing the question") and the role of obfuscation ("if you make the issue sound confusing enough, no one will vote for it").

The process by which the roles of lobbyists were selected was one of the few instances of direct intervention by faculty and staff. A single example will illustrate: two legislators wrote a bill mandating the use of seat belts in passenger vehicles. Lobbying positions for the bill included the "United Chiefs of Police of America," an insurance company, the "Coalition for Local Freedom of Choice," the United Auto Workers, and General Motors. While the lobbying positions included, ideally, two proponents, two opponents, and an ambiguous position, students discovered even more ambiguity in the roles than the design dictated.

All of the above activity was aimed at preparation for legislative hearings on each of the four bills, to be followed by a redrafting and amending process and a final debate and vote. Bills sponsored by other legislators included a proposed increase in funding for fusion energy research; a bill to prohibit the use of lie detectors and drug testing in the workplace; and a bill designed to deal with acid rain.

While some time was specifically allotted in the schedule for the activity, the intensive nature of the two-week institute tacitly demanded that students make choices about how much (or how little) of their free time to devote to the activity.

In each hearing, time was allotted for a presentation by the sponsor of the bill under consideration, followed by time for the presentation of "friendly" testimony, balanced by antagonistic presentation. "Public" comment followed; the final hour was taken up by questions from the press. Reporters chose from a list of media with predetermined ideological slants as well as representatives of the "neutral" mass-media.

The students found that the hearing procedure partially restructured both the texture and the content of subject matter under consideration. They also discovered that presentation of an argument was at least as important as the validity of the argument. Faculty and staff noted an increase in the sophistication of presentations from each hearing to the next. In particular, students learned to field tactics such as "character assassination" adroitly; they also developed tactics for subverting the authority of the moderator, an activity in which they were usually unsuccessful.

In the final vote on all four bills each of the students represented a state, and was instructed to vote their conscience unless a state or regional issue clearly precluded their predisposition on an issue. Prior to each floor vote, a short period of debate and summation was allowed.

Apart from the above requirements, there were to be no "rules." Alliances were to be encouraged; similarly, illicit activities, such as bribery through small favors (such as sodas) would not be discouraged, since such activities would almost certainly be corrected by the activities of journalists and opposition lobbyists and legislators.

It may be helpful to underscore the context in which the TAA took place. The most significant aspect of that context, perhaps, was that the TAA was *an addition* to the Institute program of the year before, which was itself the presentation of a full-semester college course in a two-week period. Few, if any, of the lectures were eliminated or restructured, although some were shortened somewhat. Accordingly, TAA intensified an already intensive educational format. Some students responded by going without sleep; others cut back in their attention to either the TAA or other segments of the academic program.

An interesting and not always desirable carry-over from the traditional context of schooling was the fact that some students responded to their increased freedom of discovery by excessive competitiveness and secrecy, in the process disenfranchising some of their less aggressive counterparts. Competitiveness might be regarded as desirable in the context of self-directed student activity if kept within moderate bounds. But excesses of it were sometimes noticed by faculty and participants and appeared to undermine the cooperative, collective nature of problem solving emphasized by several writers (Sternberg, 1985a; Meyers, 1986).

There was also a sense, again shared by faculty and several students, that student-selected problems might not be "as good" as they might otherwise have been (e.g., "as good" as problems as articulated by faculty). In other words, we ran the risk of devoting a significant portion of the Institute to "trivial" problems and solutions.

We argue, however, that it is *the process* of problem recognition, articulation, and resolution that matters, and not the outcome. In this sense, some amount of constructive "backpedalling" by the students who found in the TAA process that they "could have done better" was actually desirable. (This happened, as described above, in the case of two bills which were recast *at the students' behest.*) The literature on critical thinking and problem solving seems to stress that the process of self-discovery afforded by such activities as TAA, and insights generated by evaluation of participation in them, are often more important than their concrete outcomes. From this perspective, the TAA could be regarded as pedagogically successful if it: (1) increased students' thinking skills; (2) increased students' insight into the connection between TAA and "real-life" problem solving; (3) increased, more importantly, students' insight into what real-life problems and their solutions are like.

Here we must state and emphasize our crucial pedagogical assumption in designing and implementing TAA, which takes us beyond the Sternbergian approach and which constitutes the main theme of this paper: **in order to create an environment in which critical thinking can take place, a large degree of the control commonly enjoyed and maintained by the teacher must be relinquished, some to her or his students, and some to thin air.** There simply is no other way. To do otherwise means that one poses a problem so artificial that little or nothing of true value can be learned from it. Moreover, just because that control is relinquished, and because it is seized by people who are in the process of learning to use it, many aspects of the critical thinking cease to be "ideal." This, we propose, is a good thing.

We regard it as a good thing even if the pedagogical benefits of this design for learning critical thinking are juxtaposed to its costs and liabilities. High on the list must be mentioned a significant degree of teacher and student anxiety generated by the relinquishing of instructor control. Retreating from the customary front of the classroom and allowing students to define

the subjects of legislative bills and flesh out the content and form of specific activities was difficult for the instructional staff of the institute, a certain amount of tension between the faculty was generated in response to concerns as to what the kids were doing or if they were doing anything at all. For their part, the students were stressed by lack of traditional role expectations. While some responded well to a demand for self-direction and the high degree of ambiguity built into the design of TAA, others had a more difficult time "getting going" and continually sought direction from the staff. Our unwillingness and inabilility (because we did not have the answers, either) was not always credible and caused some resentment.

Whether these difficulties in implementing TAA were significant or mere glitches, and (more important) whether TAA served its primary functions, remained unknown for several months following the close of the 1986 Summer Institute. The authors of this paper attempted to assess that process of evaluation and insight discovery by collecting information from the participants in the Institute regarding their retrospective evaluation of TAA. Some, by definition very general, evaluation of TAA occurred at the termination of the Institute. What is significant is that though the TAA was evaluated as but one part of the fabric of the Institute program, it was spontaneously mentioned by practically all of the participants as an important part of their summer experience. Given that salience of the activity in the students' minds, we decided to follow up with an instrument specifically designed to solicit information about the TAA. A brief mailed questionnaire was sent, along with a cover letter, to all participants in February of 1987. All of the questions were open-ended, allowing for independent formulation of responses by the students, although some probes were also built into the instrument. Sixteen responses, or 38%, of the mailed forms were returned to date. The next part of the paper represents a thematic analysis of student opinions about the TAA and its contributions to critical thinking on their part.

III. Student Themes—Participants' Evaluation of TAA

Four themes stand out in students' evaluations of TAA in mailed questionnaire responses. These are (1) indeterminacy of the design of TAA; (2) selection of topics (bills); (3) real-life nature of problems; and (4) overall assessment of the activity. In the following analysis, representative quotes from the students' answers to our questions illustrate these themes.

We were interested, first, whether the students understood why the goals of TAA were left initially vague. Fourteen of the 16 respondents indicated that they did know the reasons for indeterminacy of design. One student wrote: "[It] allowed us to develop ideas that might have been snuffed out in a unambiguous atmosphere," while another said:

> At first I was confused about why the TAA's goal was so hazy—I was so used to being told not only what to do but exactly how to do it that I didn't know what was going on. Then I realized that the activity was to be directed and run primarily *by ourselves*—instigated not by the higher-ups—as the teachers had always been—the responsibility of really *doing* something out of nothing (or practically nothing!) was actually very *liberating*.

The issue of when the design became apparent produced responses of this kind: "The design became clear after my questions were continually rebuffed. I figured out they wanted us to decide for ourselves what to do within their guidelines." Another student wrote, "During the sessions (hearings) when I observed all of the people throwing everything they had into the defense or offense of the various problems, I realized how cleverly the TAA had been constructed. We were allowed to sharpen our own skills of formulating original thoughts."

Indeed, the majority (9 out of 16) had a clear idea that it was their design that prevailed (only one student indicated that the design was that of the faculty; the rest of the students gave

ambiguous answers). One student stated that "The design was obviously *ours*. The bare outlines that were given were just enough to get us started," and another that "We were allowed to design our own solutions to the problems at hand having nobody tell us if we were right or wrong. It was stimulating to be allowed to be our own judges of right and wrong."

That feeling of "ownership" extended itself even further. Even though the students gave divided answers to a question of whether they would have chosen the same topics today, a significant majority (14) felt that they were satisfied with the scope and significance of the problems they did choose.

As we have argued above, selection of problems is a central issue in critical thinking. One of our major pedagogical strategies for reducing teacher domination over the process of learning critical thinking involved an assumption that choosing a problem was as important as solving it. Fifteen of our respondents agreed. Many felt that problem choice enhanced student "interest." One student discussed the relationship between articulation and solution: "You can't effectively solve a problem to the best of your ability if you are not interested in it." Another felt frustrated by the lack of time available for research: "Choosing a problem is *key*. I think one problem with the process was the lack of time and research there was in choosing the issues."

It appears, however, that insights about the relation between the determination of problems and critical thinking as a process came to the students hard and only in retrospect. Only seven of the respondents indicated that the principle was clear at the time of the activity. It is possible to argue that their previous life experience, including the large part of it constituted by schooling, did not prepare them to understand this issue. The following quote illustrates that well: "School breaks down into components so much that it's hard to get a "big" picture; and the kinds of problems we dealt with at USM *were* part of the big picture.

The fact still remains that the participants, unaccustomed as they were to the lack of clarity of expectations, found it to be a beneficial part of TAA. Three-fourths found the fact that they were not told precisely what was expected of them profitable: "Part of what made the activity so good was the uncertainty—*not* knowing what was expected of us." Two thought otherwise: "I hate to say it, because I think it contradicts your goals, but...the confusion about what I was supposed to do and how to get it done took away from the time I could have spent to make my final product better." Two students provided ambiguous answers.

The third prominent theme in student responses to our questionnaire centered around the real-life nature of critical problems. We asked our students to reflect on Sternberg's formulation of the nature of real-life problems and followed up with a question as to whether his was a good description of the problems they face in their lives. Three quarters agreed, "Problems I have been given in school usually have a correct procedure which must be followed precisely and result in a correct answer. Very few problems (such as a relative's death) in my life have fit this form." Some of the answers, though they affirmed the description, indicated some disappointment or exasperation: "Although I do not always wish that the world is the way it is, I would have to agree with the description." The rest gave answers that do not lend themselves to simple interpretation.

Even more (there was one exception) saw Sternberg's statement of critical problems as a good description of TAA. One student wrote, "We were forced to grow up, reach the real-world-type problems. And these fit the description of Sternberg's exactly." Another stated that "If I had been asked what I had learned about facing issues after the TAA, I would have written the same as Mr. Sternberg." These statements seem to indicate that the students appreciated Sternberg's formulation of problems as conducive to fostering critical thinking.

What was also apparent is the fact that the very intensity and exhausting nature of the TAA added an element of realism and for most of the students (three-fourths of them) did not detract from their appreciation of the Institute and the activity itself. Here is a typical response: "Although at the time I disliked the intensity, now I realize that it was both necessary and good. I was forced to work very hard, and I think I grew as a result." A majority (10 out of 16) also felt that well-informed decisions in the "real" world can and must be made under circumstances of equal intensity (one student disagreed, five provided ambiguous answers). The question was more difficult to answer simply, but the responses reflect the thoughtfulness of these young people: "In the 'real' world we've only got 'real' people and the 'real' people aren't necessarily 'really' perfect," one student wrote. Another suggested that "...the 'real' world has even more intensity and this Institute just prepared us for that understanding of how things really work." And a third felt that:

> Sometimes the intensity of the activity was a little overpowering...it was hard to keep your head straight, but quiet visits to the library helped. The intensity spurred creativity but sometimes overpowered—nevertheless, in retrospect, I would have made *the same decisions.* So yes, I do think "real" decisions can be made in that atmosphere.

The final theme identifiable in the student responses is that of the overall evaluation of their experience with TAA. We asked them both a structured question and an open-ended one. Most of the student responses fall into three categories. TAA was regarded as a) a pleasant distraction from other components of the institute; b) engaging, but lacking in clear directions; or c) too unsettling to have been either enjoyable or useful. The illustrative comments read as follows:

> Because I was so enthusiastic and involved with the activity, it is hard for me to express how much the activity meant to me except to say that it was *great*—absorbing, enlightening, and personally satisfying.
>
> It was pleasant and a distraction from the other components of the institute, but I enjoyed the others just as well.
>
> ...as I 'engaged' in the activity, I was having more fun and meeting people through it. Now I feel that the lack of direction was a help. *It helped me to start finding myself through the finding of others.*

These responses seem to indicate that TAA did its job as an integrating and synthesizing part of the Institute, even though it seems that its contribution to students' abilities to think and to solve challenging and critical problems came largely in retrospect. The last response quoted points also in the direction of a real possibility that these bright, well motivated and socialized young people were also anxious to please the researchers who, after all, came up with a worthwhile and engaging activity to occupy part of their summer. This, indeed, might be a cost of *ex post facto* survey, but on the balance of it, we think the students' responses to be a forthright and thoughtful evaluation of TAA.

IV. Conclusions and Interpretations

In the introduction to this paper, it was noted that TAA was not initially designed as a "critical thinking" program; instead, it was to serve as an activity through which students of the USM Summer Institute could synthesize some fragmented aspects of a course concerning technology and society. Nevertheless, the conception of the activity contained a reference to Robert J. Sternberg. Our concluding remarks will extend that reference, and will break down our functional critical thinking/synthesizing distinction.

Sternberg has developed a useful critique of critical thinking programs, but his own program of solutions, "Intelligence Applied," seems to fall victim to the very pedagogical traps he identified in the first place. The examples given seem to illustrate a set of fragmented, idealized, often trivial and always externally imposed (e.g., imposed by the teacher) problems (Sternberg, 1985b, p. 279-280). Indeed, the very fact that Sternberg's work falls within the tradition of teaching critical thinking through logic and problem solving, would appear to deny him the claims to realism and relevance demanded of critical thought with everyday life and the discipline-grounded context of most of good and useful thinking (Meyers, 1986, p. 1-10). Meyers would argue also that that tradition excludes some forms of critical thought (e.g., esthetic experiences and their analysis, playful examinations of ideas or simply posing incisive questions) and assumes that all instances of grappling with a problem will produce a solution. We would like to add that pursuing critical thinking within the parameters of formats predicated on expectations of discrete step-like results, ultimately leading to "testing"of some abilities *and* achievements and within the parameters of teacher-imposed, externally defined problems to be "solved" by students *can only lead to contravention of critical thinking.* Individually and collectively, these concerns raise a powerful issue: is it possible to speak of "teaching critical thinking" or is such a phrase a contradiction in terms? Might it not be more appropriate, even if pedagogically more difficult and more humbling, to speak of facilitating the learning and practice of critical thinking or creating academic structures and environments where critical thinking will occur? This hypothesis might be interpreted as the guiding theme of our conclusion.

Our experience with TAA seems to indicate that if critical thinking is to mean something, it must be predicated on an active posture of the learner, and a variety of conditions stressing the collective, social aspects of critical problem solving and thinking (Meyers, 1986; to some degree Sternberg, 1985). The teacher must relinquish traditional control over the process of learning and actively resist students' demands for continual guidance. The teacher must be willing to "sacrifice" content for process, to accept student determination of problem selection and its solution, even in spite of his/her feeling that a better set of problems or outcomes could be found if only teacher control were reasserted. All this does not mean that the student-controlled process will lack rigor; rather, the ultimate rigor might reside in careful planning and structuring of a context for interactive learning (Meyers, 1986). Accordingly, our pedagogical energies might better be directed toward careful designing and planning, rather than the continual control over and direction of every phase of the learning process.

One of the hotly debated issues in the field of critical thinking is the division between those who insist on the generic and transferable nature of critical thinking and those who emphasize its discipline-bound character. The discussions at a recent conference on critical thinking attended by one of us seem to indicate that that division also translates itself to divergent pedagogical approaches to teaching critical thinking. These are either cross or interdisciplinary or are discipline-specific and thus focus on induction of the novice learner into that discipline and its community of discourse. The interdisciplinary nature of the Summer Institute and the Sternbergian inspiration of the TAA would seem to place us on one side of the issue. But it is also possible that there is a problem of misplaced emphasis here—such is the nature of most dichotomous thinking. We might be able to escape a rather sterile debate between generic vs. discipline specific camps if we insist simply that critical thinking be substantive. By saying this, we are in agreement with Meyers' (1986) critique of teaching critical through the math/logic or narrow problem-solving strategies. We are also in agreement with John Dewey's analysis of the critical thinking process, or inquiry, which holds that critical thinking is problem-specific as opposed to either generic or discipline-bound. By stressing the substantive nature of critical problems, we are addressing their "real" life, adult nature; their

contextual, non-trivial character; as well as their extremely important subjective and normative components.

In retrospect, it appears to us that proper evaluation, de-briefing and follow-up are very important concerns in designing a good program in critical thinking. Meyers (1986), whose book summarizes reflection on teaching of critical thinking, also feels that this is a crucial factor. In this regard, the faculty of the Summer Institute were probably guilty of having missed the boat. After the final hearing, we proceeded to take turns in sharing with the participants our observations on what went well or not so well with TAA. This was not a terribly creative evaluation mechanism, and while it might have suggested some points not perceived by students, it did not compensate for engaging them actively in a systematic and thorough evaluation of their experience. The students did evaluate the Institute briefly, and rather politely. The fact that TAA was mentioned spontaneously by most, if not all, of them, is a testimonial to its success and salience in the student's overall perceptions of the total program. Similarly, we can rationalize that the present research instrument provided the participants with a valuable mechanism of evaluation, aided by a useful interval. But none of these can really be regarded as a meaningful equivalent of an immediate and extensive post-mortem on TAA. Given the intensity of the activity, an equally intensive evaluation and debriefing should have occurred. We cannot help feeling that an important opportunity for learning was lost. We would stress that systematic reflection is an integral part of a good design of programs aimed at stimulating critical thinking.

In conclusion, we feel that the salient aspects of TAA and the lessons we have learned from it may be successfully transferred to a variety of learning contexts and formats, providing that the following specific aspects of the program are retained: first, programs must rigorously insist upon problem selection by *students*. Second, programs benefit from an interdisciplinary presentation of material, although we do not consider this essential; more important is that the material have about it some characteristics of "real life" dilemmas. Third, evaluation of the learning process by students *must* take place. Given these prerequisites, there is no reason why a program like TAA could not be adapted to a variety of college, summer institute, and high school formats.

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PROBLEM GENERATION AND PROBLEM SOLVING IN INDUSTRY AND ACADEME

James W. Smith

One subcategory of the process of critical thinking is problem-solving which, combined with decision-making, constitutes the major activity of many professional individuals in different forms of employment. Decisions and solutions, if they are to have any meaning, will possess certain characteristics. For example, they should be defensible against intelligent rational scrutiny and, if not totally self-consistent, should at least represent a rational weighing of numerous data inputs.

Whether there is a universally applicable methodology for problem-solving is an open question. In times past it was fashionable to cite a process of reason called the scientific method as a generally applicable technique. While this method has utility, particularly in dealing with closed-ended problems, it tends to become less useful and somewhat awkward when dealing with uncertainty.

The world of commerce and industry is a space in which problem-solving has been elevated to a high art form. Indeed, young prospective job candidates about to emerge from the nation's universities and colleges are counseled that, when asked by interviewers to explain what drives them to answer, "I like to work with people and to solve problems." If that answer sounds a bit contrived and shallow it should be remembered that a good deal of a degreed professional employee's workday, particularly in industry, is spent doing just that, working with people and solving problems. In academe problem-solving, too, is a valued skill although it is often called by different names such as research, design, or study (the words are not necessarily synonymous; one may be a component of the other).

The workday worlds of industry and academe are quite different as are the motivations of the populations and the rewards systems to which they are subjected. So, it is no surprise that the methods used for problem-solving by the two populations are often quite different. Generalizations about the behavior or traits of specific populations are risky, at best. Nevertheless, within the two groups, certain tendencies may be discerned. It is the premise of this paper that each population demonstrates, in the aggregate, certain approaches to problem-solving and that these approaches are dictated by the particular professional culture which is characteristic of that population. From these tendencies, stereotypical descriptions of the two populations can be developed. The second premise is that each population has something to teach the other.

Problem Origins

The methods used to solve problems are often markedly influenced by the nature and the origin of the problem. For example, when an origin implies urgency, the method of solution will, in general, be different than if no urgency is implied and what is considered to be an acceptable solution will also be different. So differences in both the approach and the solution will exist, even in the extreme case where both problems are identical, simply because of the time line difference.

Academic Problems

The main difference between academic problems and commercial or industrial problems is that academic problems are self or institutionally generated. Faculty members, in most cases, have the luxury of influencing, if not downright choosing, the problems to be worked on. A problem arises because a faculty member wants to solve it. Motives for the choice of problems may vary. The solution of a certain problem, or the proposal to do so, may lead to a research grant or paper, may be useful as criterion for promotion or tenure or as an exercise for students, or be simply a problem of interest to the individual. Problems generated in such an environment tend to have certain characteristics:

They tend to be focused, defined. Someone once said that a well-defined problem is half answered. Except at the most profound levels of study, what high-tech types refer to as the cutting edge, academic problems that are generally chosen have a clear definition, are not ambiguous and appear to be manageable.

They tend to be within the context of a course of study or research. This will affect both the nature of the problem chosen and its timing. The existence of a problem often becomes apparent during involvement with or study of a particular field of knowledge. In the common case of problems assigned as part of a normal course, the progression of the syllabus dictates the timing of the problem. Problems at a more advanced level, for example, those typical of faculty research most often are generated as an outcome of on-going or previous faculty academic interests and involvement.

They tend to be within areas of expertise or competence. It is rare that problems are selected outside of an individual's field of competence. Since in academe the solution to a problem, if satisfactorily documented, is viable currency, the tendency is to select problems for which past experience and expertise suggest certainty of success. This is one reason for the development both in individuals and in academic departments of in-depth knowledge, often at the expense of breadth.

They tend to be monodisciplinary. There are a number of components here. One is simply that the traditional course sequences tend to be developed along traditional departmental or disciplinary lines. At the faculty research level most organizational efforts and also fund allotments are within, but not usually across, traditional boundaries. External funding agencies such as NSF or the foundations are not structured to judge, much less fund, multidisciplinary proposals because, among other things, individual contract officers often do not have the breadth to assess them objectively. Finally, the majority of scholarly journals, not to mention the referees, are not inclined or equipped to handle works which cross jurisdictional boundaries to any significant extent.

They tend to be individual efforts. Even in cases where large research grants are sought (here the singular example of high-energy physics is discounted), they tend to be structured so that they can be broken down into units which can be managed by one individual. This is probably because much of the university population, students, non-tenured faculty, and faculty vying for promotion are in a mode where they are judged as individuals. We do not have good methods (or any particular motivation) in academe for assessing individual contributions to team efforts. The fact that an individual solved a problem is often more important than the problem itself.

They may or may not be real. Certainly, at the lower levels problems are by necessity contrived. It is just not feasible, for example, to ask a freshman to solve an original problem in physics. What is not clear, however, is what effect dealing with non-real problems, that is, their acceptance as both necessary and desirable in lower-level courses has on the mindset of the faculty when they choose their own problems.

There may or may not be time constraints. Certainly a student with a term paper deadline has time constraints as does a scholar preparing a paper for a scheduled conference. The scholar has the luxury of picking the conference and therefore selects his or her own time constraints. This is not as true of individuals involved in contract research but even there, an opportunity for time constraint management exists by judicious construction of the original bid proposal.

There may be no real measure of success or failure. Does the acceptance of a paper in a scholarly journal mean that indeed a problem was solved? Much in academe is judgmental and success is often in the eye of the beholder (or referee). Journals accept and publish contributions to the published literature of a field, not solutions to problems. Often the best measure of the solution of a problem is the relief accorded or satisfaction given to those to whom the problem affects most. If the problem is insignificant or contrived the satisfaction can get lost in the noise level.

Industrial Problems

Problems, far from being a currency in industry, are considered to be either deviations from the norm or as barriers to the orderly progression toward some objective. Their characteristics too are subject to generalizations such as:

They are seldom chosen. Industrial problems are not chosen, they occur. They are regarded as a negative entity. Problem solving per se is not an executive's objective. Rather, it is regarded as a regrettable but necessary talent in order to achieve an objective. While the ability to solve problems is highly regarded, solved problems are generally not considered to be currency, except at a small number of firms such as A. D. Little. The solving of the problem is secondary; the important thing is that the problem is solved.

They are not necessarily in the expertise of the responsible individual. This may be the greatest difference between industrial/commercial and academic problems. Routinely, problems occur which are outside the realm of expertise (or sometimes even the comprehension) of the individual charged with solving the problem or more specifically, the individual responsible for insuring that the problem is solved. The problem-solver and the responsible individual are not necessarily one and the same.

Boundaries may/may not be apparent. Real world problems often appear open-ended. Often the extent of the problem is not known until the solution is well underway. Moreover the real problem may be masked by secondary features or misinterpreted symptoms. Definition is often only by symptom.

Deadlines are often fixed. If a problem's extent is not necessarily known, the time alloted for its completion generally is. Deadlines are sometimes arbitrarily or even capriciously set; more often they are determined by the totality of circumstances involving the problem. An order which will be cancelled if quality standards of shipments are not raised to acceptable levels within a fixed period of time, a malfunctioning computer which shuts down an in-

surance office or an unknown process variation which causes the yield in a sensitive chemical process to decline precipitously are all examples of complex, not necessarily well-defined problems which, nevertheless, have fixed non-negotiable deadlines dictated by the urgency of the situation.

They have real measures for success or failure. Industrial/commercial problems are considered solved when (a) they vanish, which is to say their symptoms disappear or (b) the individual or individuals whom the problem affects most declare it to be solved. Often the symptoms of a problem disappear during the course of attempts to solve it. This is particularly true of industrial processing problems. Whether there was any cause-effect relationship between the efforts expended and the disappearance of the symptoms is not necessarily clear. Complex physical (or sociological for that matter) systems do not lend themselves to easy analysis. Individuals can declare a problem solved or, as is quite common, moot if they are willing to accept the consequences. An example might be a case where effective investigation establishes that previously attained quality levels are not realistic or sustainable and so a customer agrees to grant relief by accepting a lower quality standard. In this latter example, a solution was not attained in a classic sense, but those responsible for implementing the solution saw their responsibility discharged.

The problem is real. Problems in industry are considered problems when someone wants them solved. Conversely, if someone in authority, a customer, a superior or a line foreman perceives that there is a problem then there is a problem. The point is that the responsible individual is not necessarily the one to declare that a problem exists nor are the manifestations of the problem necessarily clear to all involved.

Problem Solving

There are some factors which affect the approach individuals take when confronted with a problem which are independent of the nature of the institution in which they occur. Experience is probably the most significant. Students of physics are dazzled by the ability of a professor to start at the beginning of a problem and methodically work toward a solution. When confronted with a new type of problem students tend to work backwards. They will go immediately to a solution and then see if it works. Backward problem solving is not just a practice of the novice. The classical method of solving a partial differential equation is to assume a solution and then show that it satisfies the boundary conditions. That is, you guess and then see if you were right. In his book "The Double Helix" James Watson described the process used to decipher the X-ray patterns for DNA. Basically it involved guessing the structure of the molecule and then showing, by laborious calculations, that the assumed structure could explain the data. Here expertise and backward problem solving were combined in an effective manner. This combination is not limited to academic pursuits. Hewlett-Packard runs a very interesting TV advertisement in which a young mover and shaker, probably a technical sales support team member, emerges excitedly from his shower, enthusiastically dials his partner and says "What if?" The implication is clear! Here is a company whose employees are constantly thinking of ways to solve their customers' problems, even in the shower! What is of interest is the methodology which is used. "What if?" is just another form of backward problem solving. In it a solution is tentatively adopted and then substituted into the problem to see if it fits.

Problem Solving in Academe

Just as the origin, even the definition of what constitutes a problem differs between the two populations, so do the methods of and the approach to problem solving. Features of the academic approach are:

Individual efforts. This stems from the individual effort orientation discussed previously which, in turn, has its roots in the value of solved problems as currency redeemable in personal rewards and gratification.

Break problems into constituent parts. Whether this is due to an ability or inclination to think abstractly, the need for documentation which forces ordering, or because they were taught to do it, academics are very good at breaking problems down into manageable parts. Good scholarship demands well-ordered thinking.

Use of historical precedent. Knowledge builds upon the base of work done previously. One vital component of a scholarly work is the literature survey. Since scholars are (or should be) knowledgeable in the literature of their field, new problems are analyzed in terms of a reference base. Because this base is common to many workers in the field, objective assessment of the work is facilitated.

Good documentation. Published papers are money in the bank. Moreover, a large and effective procedure for searching the published literature exists. The combination reduces the reinvention of the wheel in the form of resolving of old problems, although it doesn't eliminate it.

Minimal progress review. Whether working on an assigned problem, or on a self-generated one, the rate at which a scholar proceeds toward the solution as well as the direction taken toward the solution is generally considered nobody else's business. Scholars generally aren't tracked unless they're doing contract research or they have a conscientious thesis supervisor. The result is that, unless they purposely seek help, they're on their own.

Solution subject to authority. Solutions are documented and handed in to somebody, be it a teacher or a reviewer for a journal. There is a hierarchy for all scholarly work. So problem solutions are reviewed by individuals who, at least in principle, are capable of assessing the quality of a solution.

Great reliance on individual expertise. Who solved the problem is important in academe, not that the problem was solved. Otherwise, contract thesis-writing and exam-taking would be more than just a cottage industry. Moreover, problem-solving is considered to be a growth experience. There is little in the academic world which conditions individuals for team approaches.

Serial approach common. Academics approach problems with one solution at a time. This is because problem solving is regarded as a reasoned process which develops in an orderly manner. This is not to say that more than one problem at a time is not being worked on, just that for each problem there is usually only one path being taken. Another reason is that the timeline is generally not very critical.

Sense of urgency derived from commitment generally not principal driving force. A sense of urgency from arbitrarily imposed deadlines may exist but it is generally not accompanied

by any commitment to the problem itself. Conversely, while there may be commitment to a particular project, it need not develop urgency. This may be due to some sense that if a project has merit, it should not be performed in a hasty environment but develop in a more gradual manner with less chance for error.

Problem Solving in Industry

The industrial world is different from academe. Problems are annoying at best and, in extreme cases can threaten the very existence of the institution. So the motivation for solving the problem is different and so are the approaches. Features of the approaches are:

Can do or delegate. Individuals are responsible for ensuring that problems are solved, not for solving problems. Problems and their solutions have no currency value. The emphasis is on minimizing problems and their effects.

Much collaboration. The team approach is commonly used. Individuals are valued for their ability to work in teams. This implies certain personality traits and skills such as the ability to communicate well. Assembling a team is a way of focussing expertise and experience on problems. One of the principal duties of a team leader is to convince the team members that the problem is worthwhile. That brings about a sense of urgency derived from commitment to the problem.

Use of parallel approaches. Short deadlines do not permit serial approaches. Multiple, or even shotgun approaches are commonly used. Cool, detached thinking is often difficult in what, in extreme circumstances can take on a crisis atmosphere.

Use of multiple resources. The entire resources of the firm are at the disposal of the project team for significant problems. Departmental boundaries are not impediments to progress. Great use is made of consultants, both internal and external.

Use of advanced methods common. While various aspects of the industrial problem-solving process may have a disordered appearance good use is made of highly developed tools such as the Kepner-Tregoe approach, Pareto analysis and other formal methodologies. Besides being effective, most of these techniques have the advantage of being widely disseminated and well documented so that they can be applied rapidly. Their use, in effect, imposes an order which might not otherwise exist.

Tracking. Individuals or even teams are periodically, sometimes daily, reviewed. While this may cause a level of stress it does ensure that progress is made and that approaches to problems are constantly subjected to peer review.

Brief or non-existent documentation. There is a certain "wing it" nature to industrial problem solving which adds a degree of disorder to the process and disorder is generally not documented. Moreover, there is nothing in the reward structure which encourages documentation. The result of this is the common reoccurence of the same problem, perhaps in a slightly different form.

Problem not necessarily solved. The emphasis is on the elimination, not the understanding of the problem. Unfortunately, when the symptoms of the problem vanish, the problem all too often is assumed to be solved. Sufficient effort is all too infrequently given to understan-

ding the underlying causes of problems. It is quite common for the same problem to reoccur constantly and for the individual responsible for solving it before to be asked to do it again.

Summary and Conclusions

In the foregoing, rather stereotypical descriptions were developed for problems, their place, origins and approaches to their solution in two different spaces, industry and academe. In a broad sense, with the possible exception of areas such as sculpture and creative writing, most scholarly works can be cast as solutions to problems. So academe is collectively an institution which is intimately involved in the problem-solving business, as is industry, but for far different reasons. Each institution has a defineable approach to problems and each has its strengths and weaknesses. Each has something to teach the other.

Academe can learn from industry about the approach to multidisciplinary problems which cut across traditional jurisdictional boundaries. Part of the industrial method utilizes a team approach which lends itself to multidisciplinary work better than a single contributor format. Participation in a team is not easy for everyone. It becomes more appropriate in circumstances where the problem's solution is the principal driving force, not the benefits which the individual accrues from solving the problem. So perhaps one lesson is that a shift away from individual emphasis may allow more profound problems to be addressed. Another lesson which is relevant is the importance of time.

Academe has much to teach industry too. The structured approach and formalized definition of problems can be just as useful in the crisis atmosphere of industry. The solution of a problem by first defining it in a formalized manner and then approaching it rationally would seem far preferable to simply alleviating the symptoms. Problems which reoccur because they weren't solved completely the first time or have to be redone because of incomplete documentation are wasteful of scarce resources.

Other lessons may emerge from the text. One technique which is not commonly used but is applicable to both spaces is the post mortem. This is a method of formalizing the concept that we learn by our failures. When a project fails problem-solving techniques are used to determine why it failed and the analysis is documented in a formal manner. The post mortem becomes a learning experience which, hopefully, at once adds to problem-solving skills and prevents the same problem from recurring.

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COGNITION AND LEARNING IN SPECIAL EDUCATION

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The discipline of special education has focused primarily on the acquisition and generalization of basic skills and concepts. Historically, the field of learning disabilities has sought to identify and isolate the underlying processes and behaviors that empower or retard the teaching-learning process. This has led at different times to a variety of recommendations for process training and skill remediation. Presently, the field is attempting to integrate process training with behavioral modification through an elaboration of the metacognition construct and the development of cognitive training models. Metacognition, a buzz word in the field of learning disabilities, can be defined simply as "Knowing how to go about the process of learning" (Lerner, 1986, p. 523).

Researchers are attempting to alter the thinking skills of learning disabled students by training them to self-regulate learning and self-monitor their comprehension and accuracy (Paris & Oka, 1986). It is believed that learning disabled students must be trained in the use of specific strategies and convinced of their benefits as well. At the onset of training, the teacher initiates and controls the use of learning strategies through instructional design and then facilitates, through a series of steps, the transfer of control from teacher to student (Palinscar, 1986). The issue of transfer is crucially important because, not only must strategy control be transferred from teacher to student (Gelzheizer, Shepherd, & Wozniak, 1986), but also from one activity to another, situation to situation, subject to subject. To make this transfer possible, some research findings support the need for intensive training, overlearning, and extensive practice to promote automaticity (Gelzheizer, Shepard, & Wozniak, 1986; Torgesen, 1986).

At the Institute for Research in Learning Disabilities at the University of Kansas, researchers have developed an extensive model for cognitive strategy training. It is believed by these researchers, and they have generated empirical evidence to support their belief, that these strategies, once learned, are effective, that strategies can be acquired by LD adolescents through extensive training, and that generalization of learning strategies and their desirable effects can be made from a controlled laboratory setting to classroom and outside use. However, even Deschler (Deschler, Schumaker, & Lenz, 1984a), the Institute Director, is not unqualifiedly supportive of learning strategy instruction. He cautions that 1) knowledge of and evident ability in the use of appropriate metacognitive strategies does not guarantee their use; 2) training materials and tasks tend to be artificial; 3) other student attributes, such as motivation and frame of reference, may undermine the effectiveness of training; and, 4) there appears to be little application of metacognitive strategies to basic skill acquisition.

The experimental nature of cognitive strategy training is underscored by Shepherd (1985). She believes that although the logical case for strategy training is relatively strong, (after all, we all have acquired and use study skills) the empirical case is presently still very weak. Such training should be considered experimental and instructional time devoted to it should, at present, be kept to a minimum. She suggests that while more experimental studies will properly be restricted to laboratory conditions, the regular curriculum may be enhanced by study skills instruction focusing on a goal of independent strategy use and the employment of mnemonics for learning facts (1985). There are serious questions, then, that cognitive strategies, once learned, will be used and, perhaps more importantly, that they can be

ding the underlying causes of problems. It is quite common for the same problem to reoccur constantly and for the individual responsible for solving it before to be asked to do it again.

Summary and Conclusions

In the foregoing, rather stereotypical descriptions were developed for problems, their place, origins and approaches to their solution in two different spaces, industry and academe. In a broad sense, with the possible exception of areas such as sculpture and creative writing, most scholarly works can be cast as solutions to problems. So academe is collectively an institution which is intimately involved in the problem-solving business, as is industry, but for far different reasons. Each institution has a defineable approach to problems and each has its strengths and weaknesses. Each has something to teach the other.

Academe can learn from industry about the approach to multidisciplinary problems which cut across traditional jurisdictional boundaries. Part of the industrial method utilizes a team approach which lends itself to multidisciplinary work better than a single contributor format. Participation in a team is not easy for everyone. It becomes more appropriate in circumstances where the problem's solution is the principal driving force, not the benefits which the individual accrues from solving the problem. So perhaps one lesson is that a shift away from individual emphasis may allow more profound problems to be addressed. Another lesson which is relevant is the importance of time.

Academe has much to teach industry too. The structured approach and formalized definition of problems can be just as useful in the crisis atmosphere of industry. The solution of a problem by first defining it in a formalized manner and then approaching it rationally would seem far preferable to simply alleviating the symptoms. Problems which reoccur because they weren't solved completely the first time or have to be redone because of incomplete documentation are wasteful of scarce resources.

Other lessons may emerge from the text. One technique which is not commonly used but is applicable to both spaces is the post mortem. This is a method of formalizing the concept that we learn by our failures. When a project fails problem-solving techniques are used to determine why it failed and the analysis is documented in a formal manner. The post mortem becomes a learning experience which, hopefully, at once adds to problem-solving skills and prevents the same problem from recurring.

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COGNITION AND LEARNING IN SPECIAL EDUCATION

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The discipline of special education has focused primarily on the acquisition and generalization of basic skills and concepts. Historically, the field of learning disabilities has sought to identify and isolate the underlying processes and behaviors that empower or retard the teaching-learning process. This has led at different times to a variety of recommendations for process training and skill remediation. Presently, the field is attempting to integrate process training with behavioral modification through an elaboration of the metacognition construct and the development of cognitive training models. Metacognition, a buzz word in the field of learning disabilities, can be defined simply as "Knowing how to go about the process of learning" (Lerner, 1986, p. 523).

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generalized to a variety of academic tasks. Deschler has suggested that the ability to generalize strategies is so important that the goal of generalizability should serve as a framework for the entire strategy learning sequence (Deschler, Schumaker, & Lenz, 1984a, p. 115).

Graham (1985) suggests that the behaviors students bring into the classroom, especially in the metacognitive areas of engagement and self-monitoring of resources, impact the ways in which they approach tasks and process information, which in turn, influence their rate of learning. Although adolescents with learning problems tend to plateau in their acquisition of academic skills (Deschler, Schumaker, Lenz, & Ellis, 1984b), the quality of the classroom social context and instructional program can influence the students' mastery of basic skills. It is currently believed that the following instructional elements have a positive effect on learning outcomes: explicit instruction, probing, modeling, practice, feedback, self-monitoring for comprehension. Graham focuses on classroom interactions as a means to produce positive learning results.

Presently, there is growing belief in the efficacy of direct instruction of learning strategies for students with learning problems. Cognitive training, however, is at the experimental stage, where it should remain, until empirical evidence validates this training as resulting in positive educational gains. It appears that, at the present time, the most promising avenue for increasing basic skills acquisition and developing thinking skills for mildly handicapped students is through investigation of and improvement in the classroom-based teaching-learning process. An examination of the literature on teaching and learning within the social context of the classroom follows.

A Review of the Literature on Classroom-based Learning

Teaching and learning are inextricably woven in the minds of educators and laymen alike, but the precise relationship of the two has long been a source of interest and uncertainty. At the present time, teaching is thought to precede learning, but little more is considered certain. It is acknowledged that teaching does not always precede learning, nor does learning always follow teaching. There is also thought to be close connection between behavior and learning. It is student behavior that results in learning. As Philip Schlechty (1976, p. 29) has written, "It is the business of teaching to induce those behaviors which are assumed to be antecedent to learning, learning being the desired consequence of the behavior." "Whether students do, in fact, behave the way the teacher attempts to induce them to behave, is a question for empirical study" (p. 26).

Student behavior, which can be characterized as "involved," is believed essential for learning to be achieved. Philip Jackson (1968), in his naturalistic study of classroom life, has pointed out that early research focused on the visual manifestations of attentiveness, but later research exposed the fallacy of equating perceived attentiveness with achievement. Although attentiveness remains an important concern for both students and teachers, he considers involvement a more significant educational goal. Edwards and Furlong (1978, p. 116) have this to say about the necessity of student involvement, "...teachers can never actually transmit knowledge, for they are still dependent on the pupil undertaking his own interpretive work and making the necessary links for himself." "...(T)he teacher can only restate the task, explicate it, make the instructions clearer, and hope that the pupil makes the necessary links" (p. 113).

Once the desirability of involved behavior has been established the question arises, 'Involvement in what tasks?' In reporting their study of a middle school classroom, Smith and Geof-

frey (1968, p. 239) make the observation that "Somewhere between the overt behavior of the teacher and the growth of pupils, one needs a set of intermediary variables," which they have labeled "activity-structures." It is exactly this notion of activity structures that Walter Doyle (1982) explains in two propositions which are basic to his work on classroom task structures:

1. Students' academic work in school is defined by the academic tasks that are embedded in the content they encounter on a daily basis.

2. Students will learn what a task leads them to do, i.e., they will acquire information and operations which are necessary to accomplish the tasks they encounter (p. 6).

For Doyle, it is the academic tasks themselves which begin the process through which students learn.

Academic Task Structures

Doyle (1977, 1979, 1980, 1982) grounds his work of describing and analyzing academic tasks in cognitive psychology theory of learning and mental development. Jean Piaget had the most profound influence on the field of cognitive psychology. He proposed that the mental development of children occurs in a series of sequential stages of increasing complexity. The stages are hierarchical, with each succeeding stage dependent on a satisfactory development of those that precede it. The stages are accomplished as children explore their environment and slowly develop mental representations of the objects and events they experience. These mental representations are termed schema, a series of which form the schemata or cognitive structures of the individual's mind. Future events or objects encountered in the environment are given meaning when individuals assimilate them into forms that are consistent with their cognitive structures, or when individuals' existing structures are altered to accommodate the perceived meaning of new experiences. The most valuable school tasks are thought to be those that promote accommodation.

Optimally, students who are involved in classroom tasks will learn; in reality, there are countless variables which promote or retard classroom learning. Doyle describes classrooms as fraught with ambiguities and inconsistencies, discontinuity and incompleteness, "...a mass processing system that is not always responsive to individual needs" (Doyle, 1977, p. 178). Because there is little opportunity for students to interrupt the system for clarification, students possessing certain abilities are more successful in negotiating the classroom terrain. Those who can exercise perceptual selectivity, those with a good sense of timing, and those blessed with patience are better equipped to monitor the wide band of information sources and to interpret conflicting feedback.

Sometimes little learning seems to take place. In discussing classroom activities which are meant to result in concept attainment by a group of lower class youngsters, Smith and Geoffrey stated, "...(We) were impressed throughout the semester with the limited learning that occurred and was retained. In thinking about this, the key issue to which we always returned concerned the appropriateness of this curriculum for these children" (p. 191). Doyle theorizes that for learning to take place the student's information processing response must be activated, and the level of cognitive processing that is activated determines the nature of what is learned. Teacher behaviors and instructional materials influence learning only to the extent that they activate students' information processing responses.

Academic learning is influenced by the nature of the tasks assigned to the students, because these tasks dictate the level of information-processing activities engaged in by the class

members. Naturally, students vary in their ability to identify and adapt to the required level of cognitive processing. They also differ in their dependence on explicit cues and prompts, which may or may not be provided by the teacher. From this point of view, the sum of the classroom task structures and the support structure provided by the teacher can ultimately predict for the students what is learned. If the task demands exceed the special needs students' capabilities, there are a number of possible outcomes: failure and alienation, polite passing, or intervention to bring about a kind of 'cognitive matching.' Conversely, if a special needs student remains throughout his/her school career on a memory or pre-memory level, learning may be limited to that level.

The Social Context of Learning and Cognitive Development

Although cognitive psychology has been instructive in conceptualizing student processing of academic tasks, some theorists hold that it is inadequate as an explanatory structure for analyzing classroom teaching and learning. Barbara Rogoff (1984) in her introduction to *Everyday Cognition*, argues that cognitive psychologists spend too much time describing the development of mental structures within the individual and too little attention to the social context of learning. She criticizes the assumption that the mental structures of the individual allow generalized cognitive problem solving across situational contexts. She believes that individuals' skills are limited by the context of the problem, e.g., the physical and conceptual structure, the activity's purpose, and the social milieu. She bases her argument on the work of Vygotsky (1978) who proposed a crucial role for social context in human cognitive development. Vygotsky suggested that the social context affects cognitive activity on two levels: 1) social cultural history provides tools and practices that influence learning; and 2) adults and other knowledgeable people transmit information about the tools and practices to children. These social interactions assist in structuring cognitive activity. In other words, the interpersonal activities are slowly transformed into intrapersonal mental abilities.

Vygotsky (1978) did not see a clear distinction between development and learning; in fact, he saw cognitive development as resulting from the interaction of maturation and learning. Because he stressed the contribution of learning under the tutelage of adults to the child's development, he gave importance to the period of pre-independent problem solving which he termed the "zone of proximal development." This phrase describes the mental activity that an individual is capable of, but only with the guidance of a more knowledgeable person; for example, those activities children can imitate but not complete independently are within their zone of proximal development. It is clear that there are many activities with which, regardless of the amount of modeling available, children can not have success. These activities are outside the zone and consequently have little or no pedagogical usefulness.

One deduction that Vygotsky's theory led him to was that curriculum for retarded learners should not be mediated solely through concrete activities. Not only is concreteness inadequate in moving any student toward higher cognitive functioning, it can reinforce handicaps. According to Vygotsky concreteness should be thought of as a stepping stone for developing abstract thinking. As reported above, learning disability specialists are currently attempting to train students in the use of strategies to promote comprehension and accuracy in accomplishing academic tasks. These cognitive strategies are the stepping stones that can lead students to processing on a comprehension level. The role of the teacher as initiator and change agent in developing cognition in learning disabled students is considerable. Some teaching strategies have more affinity for this concept of cognitive development than do others.

A teaching strategy that takes advantage of the zone of proximal development is known as "scaffolding." This term was coined by Wood, Bruner and Ross (1976) as a metaphor to describe a pedagogical strategy that bridges the gap between task requirements and the learner's skill level. The scaffold in the building construction trades has the following characteristics: 1) support, 2) tool, 3) range extension, 4) extension of task completion ability, 5) selectivity of use. Scaffolding is meant to allow task accomplishment without error or failure through teacher intervention as needed. Learning tasks, mediated through the scaffolding technique contribute to the students' independent skill development, and as these capabilities increase, the zone of proximal development shifts. The crucial difference between building construction scaffolding and instructional scaffolding is that one is a physical support and the other is an interactive relationship. Scaffolding as an instructional strategy can be illustrative of one means by which social interactions play a crucial role in the growth of human cognition. It was pointed out by Greenfield (1984) that scaffolding is more commonly employed in informal learning situations than in formal school settings. This may be because school teachers are more inclined to let students fail in their tasks and learn from their failures. Scaffolding as a teaching strategy is probably underutilized in the school situation.

It appears that human interactions in the classroom have significant and substantial influence on learning outcomes. In addition to the social, contextual foundation for cognitive development, students and teachers alike develop a variety of interactive strategies for controlling the classroom environment, achieving goals, and making the school experience personally meaningful. It is possible that for students with learning problems, human interactions are even more important than for their average classmates. Certainly, strategy training initially presumes an intensive union of teacher and student, as does the technique of scaffolding. It is possible that the behavioral model for designing instructional sequences has tended to obscure the crucial role of relationships in the learning process. An examination of the experiences and relationships of learning handicapped students within the natural milieu of mainstream classrooms may provide insight about practices that advance or retard learning. Some of the findings from a qualitative, classroom-based study of special needs students in mainstream secondary classrooms follow.

Qualitative Study of Special Needs Students in Mainstream Classrooms

This qualitative study was based in the regular classrooms of a public secondary school where the researcher worked for the previous five years in the special education department. The school had 550 students and was homogeneous *vis a vis* socio-economic status (upper-middle), race (white), religion (protestant), and values (conservative). Classrooms were chosen to provide the opportunity to observe some of the students in more than one setting. The majority of mildly handicapped students were mainstreamed into non-college preparatory courses in this high school. Twenty-three identified special needs students were observed interacting with teachers, non-special needs students and other handicapped students, while processing the curriculum, responding to performance demands, and engaging in social interactions. A total of six freshmen were observed in four different settings; one freshman and one sophomore were observed in three settings; eight students (two freshmen, four sophomores, one junior, and one senior) were seen in two settings; and seven (one freshman, one sophomore, four juniors, one senior) were observed in one setting.

The study examined and weighed the significance of major factors of classroom life for special needs students. Arrangements were made to spend several weeks in each of six different mainstream classes, as well as to interview teachers (or teams of teachers) and special needs

students about their views of classroom experiences. The data were accumulated in field notes, tapes of interviews, and taped classroom interactions. Significant information about the teaching learning process was discovered and documented through a qualitative examination of routine classroom activities. A report follows of the findings that impact on our knowledge of the teaching learning process as experienced by a group of special needs students in mainstream classes.

I. Special needs students shared some behaviors with their disabled and non-disabled classmates, but each presented an individual learning profile. Many of the students' learning characteristics have been enumerated in the literature. For example, some demonstrated limited receptive and/or expressive verbal abilities; they had difficulty with multi-step processes; problems extracting and resynthesizing embedded information; and, deficits in temporal, sequential operations. In general, they displayed a tendency to confusion in the realm of concepts, word meanings, naming, sequencing, and logical conclusions. The picture of student learning characteristics that emerged suggested that students with impaired learning abilities are a heterogeneous group with individual learning profiles and overlapping characteristics.

II. Student learning characteristics tended to drive their academic task preferences. Students who go into classrooms with significant learning disabilities, especially verbal and memory deficits, are often concerned about surviving academically and at the same time about presenting themselves in a positive light for their classmates. They preferred discussions to lectures, but felt comfortable only when discussing topics for which they had a developmental or emotional interest and a conceptual base. Preferred activities that emerged during this study included competitive games, independent, individualized projects, and activities that were infused with social relations, either as part of the task structure (oral reading of plays) or which were routine enough to permit on-going socialization.

III. The students demonstrated strategies for influencing the classroom task structure. Students had numerous strategies for getting the kinds of assignments they wanted. They sought to reduce the challenge margin of assignments and to increase socialization by seeking non-threatening class activities with a social component. They minimized unwanted assignments by stalling, getting the teacher off the subject, packing up early, subtly encouraging acting out by classmates, and generally giving negative feedback for unwanted tasks. They worked to hold down their teachers' expectations for productiveness by carefully monitoring time on task to delimit the work production rate. Time on task was reduced by lengthening the transition periods at the beginning and end of each period and by taking regular breaks during independent seatwork. Students were also observed to give tacit acceptance and mild encouragement to strategic deviant behavior by some of their classmates which had the effect of delaying or interrupting the academic business. In a proactive manner students provided reinforcement to teachers who assigned desired tasks through expressions of enthusiasm, listening attentively, praise, and a show of busyness. In these ways students exercised considerable control over the classroom proceedings.

IV. The teachers were also observed to devise and execute strategies for achieving goals. The teachers attempted a variety of means for coping with and alleviating the effects of learning deficits displayed by their lower level students. A major strategy was for teachers to create a classroom ambiance that neutralized the academic evaluative process. An important instructional strategy was for the teacher to build a meaningful knowledge base from whole class activities, such as discussions, oral reading, and routine tasks, while continually acting as a scaffold for the students' performances. Another teaching strategy was to break more

complex tasks into small units. Each portion was treated as discrete and was structured and monitored in much the same way that a total project might be for higher functioning classes. In this way, many students were able to handle work that was beyond their level of cognitive development.

Teachers accurately discerned that the concepts underlying certain curricula were beyond the comprehension of many of their students. They responded by concretizing the language and formularizing the activities of the academic task structure. Thus, the teachers instructed students in equation solving with "get rid of this" or "move this over here." So, too, they substituted critical thinking skills with common road map directions, "Just follow the formula on the board," and "Go down one side and up the other." Both of these strategies (componentization and formularization) made it possible for non-college preparatory students to process information and ideas and produce work at a higher level than they would be able to in a less structured situation.

V. A behavioral analysis of learning tends to obscure the complex, social nature of the learning process. The teachers who served as subjects for this study tended to analyze the teaching learning process in behavioral terms and to focus on the independent behaviors of the students. They have been trained that learning occurs in a logical, sequential mode and that if they break the curriculum into small enough units, students will make progress. That students often do not make progress, according to this theory, can be traced to student behaviors, usually in the form of non-application. Consequently, teachers put their efforts into minimizing the breadth and depth of the tasks, structuring and supporting the activities, and influencing the students to diligently follow a prescribed sequence of learning activities. To the extent that they failed to design an academic task structure that was within the students' conceptual range or connected to their shared knowledge base, the resulting approximations of classical high school curricula were reduced in meaning for the students and lacked an essential precondition of learning.

VI. The students' social agendas often dominated the classroom business and frequently were at odds with the teacher designed learning sequences. Secondary students are developmentally at a stage when both their external and internal lives are dominated by peer interaction. It was observed during the study that most, if not all, of the students maintained a strong social agenda during school time that only occasionally intersected with their teachers' and their own academic agendas. The students attempted to influence academic activities to enhance their social agendas: they promoted and supported activities that either created time for socialization (e.g., loosely supervised independent seat work) or activities whose structure was inherently social in nature (e.g., games or play reading).

VII. Teachers' views of the teaching/learning process did not adequately incorporate the social nature of their students. It appeared that most of the adolescents observed filtered the academic tasks through social relationships. Students with impaired learning abilities seemed especially dependent on relationships of a supportive nature to function academically. Although there were many examples of effective use of social interaction to support the curriculum, it appeared that the teachers underestimated the social component of learning. They relied too heavily on a behavioral, positivist view of learning as an individual venture, properly, although only occasionally pursued through interaction of the self with the environment. The instructional strategies chosen to accommodate special needs students tended toward individualization of assignments and concretization of ideas. The math and science teachers had some success with these strategies, but their success was limited by the particular learning characteristics

(weaknesses in memory, sequencing, and organization) of their students and the failure of the task structure to lead to a comprehension level.

The humanities teachers, on the other hand, demonstrated a commitment to relationships as mediators of the task structure, but their interpretations fell far short of what was needed. In social studies, the teacher displayed a special sensitivity to the students' need for an emotional hook to process ideas effectively and to their responsiveness to her personal involvement in the writing process. The English teacher successfully exploited the teacher/student relationship to engender good student involvement in a shared creation of knowledge at a fairly high cognitive level through his use of scaffolding as a teaching technique. Both of these teachers ultimately drew back from a logical extension of their interactionist perspective on teaching and failed to maximize their successes. In social studies, the individualization of assignments discouraged content-related communication and allowed the students to exploit the loosely structured class time for social communication. In English class, there was no discernible effort on the part of the teacher to withdraw the "scaffolding effect" in order to move students toward unstructured, generalizable learning.

Cognitive psychology learning theory drives present day educational efforts for low-achieving students. These efforts are manifested by attempts to train students in the area of cognitive strategies and by the use of a direct instruction teaching approach in classrooms. There is a growing awareness that the quality of classroom social contexts and instructional programs can influence the learning outcomes of adolescents. A qualitative approach was chosen to examine classroom-based teaching/learning processes. The findings suggested that a behavioral analysis of learning may be promoting practices which often lead to a breakdown in the teaching/learning process. It was also suggested that viewing learning as an interactive social process would engender a perspective on learning that more accurately incorporates the social component. This could lead to recommendations for instructional strategies that exploit classroom relationships and channel students' social drives to the achievement of academic goals.

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THINKING ABOUT HUMAN RELATIONSHIP: WHAT CHILDREN KNOW

Susan Cook

I am going to talk about a theorist whose ideas about how children think have been embraced widely by American psychologists and by educators. The theorist to whom I make reference is the Swiss psychologist Jean Piaget. My claim is (and the data that I'll present suggest) that Piaget and others who followed him have made some inaccurate generalizations about the contribution of logical thinking to children's grasp and knowledge of human relationship. One consequence of these generalizations is that psychologists have seen young children as having a knowledge of human relationship that is compromised. Data from two studies will be presented: a small longitudinal study of 10 boys and girls (7-10 years old) and a larger study of 59 first, second and third grade boys and girls (6-10 years old) in which they were interviewed at length about their conception of family relationship. Two areas of children's knowledge of family relationship that I'll talk about are: 1) children's recognition of continuity in family relationship; the unconditional membership of every human being in family; and 2) children's recognition of perspective in family, that is, perspective as a possible location of self and other in responding, receiving and sharing human kindness and sometimes malice.

These data and my explication of them will clarify aspects of awareness that Piaget's depiction of children's knowledge of human relationship fails to capture. Piaget has contributed immeasurably to what we understand about the growth of the child's ability to reason about the physical world: to use logic to demonstrate intelligence. This broad application of logical thought to the social realm may lead theorists to a narrowed vision of the contribution of the experience of relationship to human development. Carol Gilligan (1982) has described the ways in which this narrowed vision of human relationship has been repeatedly evoked in psychological theory. Piagetian theory applied to children's knowledge of human relationship may be yet another domain of theory in which paradoxically the vision is narrowed and the centrality of relationship overlooked.

A number of American psychologists have applied Piaget's theory about the growth of the child's ability to make sense of the events of the physical world to the growth of the ability to make sense of the events of the social world: the world of people and relationships (Borke, 1975; Chandler, 1973; Flavell et. al., 1968; Selman, 1980). The body of literature which has emerged examining the application of logical thought to the child's social knowledge is collectively called, "social cognition." This area of psychology looks at how we make sense of human relationship: how we reason, how the twists and turns of our activities with others are represented in thought.

This application of Piaget's theory of the growth of children's logic to the social world has led to two confusions in our understanding and study of how children know and grasp relationship. These two confusions suggest that Piaget's theory incompletely captures the complexity children bring to thinking about human relationship.

The first confusion that Piaget's work has fostered is a confusion between the idea of relationship and the fact of relationship. The second confusion that Piaget's work has fostered

is a confusion between the idea of perspective or point of view in relationship and the fact of perspective in the experience of relationship. These two different confusions have a common thread: the common problem of losing the distinction between the child's ability to grasp an idea through logic and the child's ability to grasp a fact, through observation of relational experience.

An early Piagetian study demonstrates the first confusion between the child's ability to know the idea and the fact of relationship. In 1928, Piaget published, in *Judgment and Reasoning of the Child,* the results of a small study of 30 boys aged 7 to 10 in which he asked his subjects to define the meaning of family. Piaget's study of the growth of logic centers on the quality of the child's idea. Growth of the idea is reflected in the emergence of ability to hold two ideas about something in mind at the same time and recognize that two ideas seen together are different than either idea held separately. The most familiar example of this ability is the conservation of liquid task which Piaget used to show that the thought of the young child focuses on only one dimension or idea about an observation. The single idea is represented in the notion that only one characteristic dictates how much water the container holds. Young children say a tall and thin beaker holds more water than a short wide beaker because it's taller and do not recognize how "thin" enters into the problem. The more mature reasoner sees that two ideas taken into account at the same time create a different idea. The older child sees that tall and thin are not necessarily more than wide and short, because the two ideas taken together compensate for each other. They create a different idea—the idea of compensation. This dynamic of logic is taken for granted among older children. Logical development occurs through this weaving of ideas and the child's inclusion of the consequences of this weaving in understanding of how the world works.

In the 1928 study, Piaget set out to see how children apply logic to their thoughts about family relationship. His study of 30 boys revealed that reasoning about the concept of family can be placed at three different stages. Focus on the single "idea," Piaget says, leads children at the first stage to have a limited idea of family conditioned on the premise of physical presence. Boys at the first stage say a family is people who live together. Seeing the "single idea" of "living together" generated by the immediate perception, they use the immediate perception to define family. At the second stage, Piaget says, the idea of relationship intervenes but does not yet supplant the fact of living together. Family relationships, therefore are "not yet thought of, by the child, as independent of time and place" (p. 118). It is not until late childhood that children go beyond the immediate observation that families are physically together and entertain a representation or idea of family that is independent of time and place. It is only at the end of childhood, Piaget says, that children have an idea of family as blood relationship, an idea that means that a family can be physically apart and still be a family by virtue of their blood tie to each other. Thus, according to Piaget, the child cannot entertain an idea of family as continuous and on-going, despite physical separation, until late childhood.

Piaget's observation about what children know about the continuity of family contradicts a readily made observation about the conditions under which children live. Children belong to families. Belonging to a family is an experience of membership, that, for most children, is unconditional and for all children is continuous and irreversible by virtue of biological relationship. Did Piaget mean to suggest that children do not recognize this connection between people until the end of childhood? Did he believe that it is the growth of logic that brings this awareness to children? That the idea of family relationship overrides the fact of relationship in children's lives? Or that children's inability to represent family as an idea undoes the fact of family tie? This contradiction between what children know by virtue of logical ability and what children know by virtue of experience presents the first confusion.

In 1980, I began to study the question that Piaget had addressed in 1928: do children see family relationship as continuous? I will describe how my family data and Piaget's data conflict.

The technique used in studying children's conceptions of family is somewhat different than Piaget's although his "methode-clinique," in which the interviewer follows the line of thought suggested by the child, was used in interviewing subjects. Rather than asking children to define a family, I asked them many different questions about how family relationship works and I asked very directly about whether family is "independent of time and place," whether they could see the continuity of family membership.

Here is a 9 year old girl, the daughter of divorced parents, who participated in the first longitudinal study. She was asked,

"DOES A FAMILY EVER STOP BEING A FAMILY?"
"No, it always stays a family."
"WHEN YOU'RE 50 AND YOUR SISTER IS 53, WILL YOU STILL BE A FAMILY?"
"Yes."
"WHY?"
"Because you're their daughters, and you can never break a family. Once you're a family, you're always going to be a family."
"WHY IS THAT?"
"Because you were once children, what belonged to them, well, half-belonged because you don't really belong to anybody."

A second grader asked the same question:

"DOES A FAMILY EVER STOP BEING A FAMILY?"
"Never."
"HOW COME IT NEVER STOPS?"
"Because they will always be together in their heart."
"WHY WILL THEY ALWAYS BE TOGETHER 'IN THEIR HEART'?"
"See, you can only remember people from your heart. Like when your grandfather dies, you'll always remember him, right? So that's why."

A first grader who was interviewed in the second larger study was asked:

"DOES A FAMILY EVER STOP BEING A FAMILY?"
"No."
"HOW COME?"
"Because the mother keeps on having a baby and the baby keeps on growing up to have another baby and the family keeps on going on and on and on."
"ANY OTHER REASONS THAT A FAMILY DOESN'T STOP BEING A FAMILY?"
"Not that I know of."

And another second grade girl:

"DOES A FAMILY EVER STOP BEING A FAMILY?"
"I don't think they would."
"WHY NOT? WHY DOES A FAMILY ALWAYS STAY A FAMILY?"
"Because once you have children, it's hard to put them back. You've got your ...you've got one."

And finally, we hear Sam, a seven year old boy:

"WHEN YOU'RE 50 AND YOUR SISTER IS 53, WILL YOU STILL BE A FAMILY?"
"No."
"HOW COME?"
"Because I think when you're 20 you sort of go out a lot and you sort of don't come home very often and you, like, stay out late and then finally one day you get married and then that's when you really don't see your family very much."
"SO, IF YOU DON'T SEE YOUR FAMILY VERY MUCH DOES THAT MAKE IT NOT A FAMILY?"
"Well, no. We're still a family, but we're still not broken up."

Remembering Piaget's contention that logic is the art of proof, I asked Sam to prove his point:

"YOU'RE STILL A FAMILY, BUT YOU'RE STILL NOT BROKEN UP. HOW COME YOU'RE STILL A FAMILY?"
"Because ... that's a hard one ... Because you're still a family. Like your Mom and Dad still remember you and they have pictures of you when you're young and stuff and you'll always be a family and even when Mom and Dad die, we'll still be a family because I'll always remember them."

What we see in the responses of young children is a portrait of their awareness of the continuity in human relationship very different from that which Piaget presented. In these data, the fixation on the immediate reality, the groundedness of the child in the present that Piaget said precludes recognition of family relationship as independent of time and place brings them to see their family membership as a relationship that will always exist. The immaturity of logic, the representation of their experience in ideas, leads to a naivete that has precisely the opposite meaning of that which Piaget offered. What the children cannot see is that families can be broken.

The daughter of divorced parents who, at age 9, said that children belonging to parents is part of what keeps a family a family, sees at age 12 that other things maintain the continuity, despite life events, despite all the ways in which human relationship is transformed. She is asked at 12 years, 5 months:

"DOES A FAMILY EVER STOP BEING A FAMILY?"
"They're always a family, but not, they don't always have to be a close family."
"WHAT DOES IT MEAN TO BE A CLOSE FAMILY?"
"To live under the same roof."
"IS IT ONLY LIVING UNDER THE SAME ROOF?"
"No, close by actually caring about their problems."
"WHAT DOES THAT DO FOR PEOPLE?"
"It lets them know that there is a person who cares about them and lets them talk about their feelings and maybe they can find a solution."

Her older sister knows that there are many ways to sustain relationship despite divorce, death or separation. At 11, her older sister had said:

"DOES A FAMILY EVER STOP BEING A FAMILY?"
"I guess sort of and not really. Not really because you'll always be a family. You would always

be, let's say, your daughter or your brother. As long as you live, but I guess you could run away or sort of disown your parents or disown your ..."
"CAN YOU DO THAT?"
"Sort of I guess you could. Just say I hate you. Get out of here. You know. But you'd still be your mother or daughter."
"WHY?"
"Because they still had you and you had something in you. You know. A piece of you."

Why did Piaget suggest that children's ideas of family do not incorporate continuity until late childhood? Why did he confuse the child's ability to know the idea of relationship with the child's ability to know the fact of relationship? If we believe that logical thought seen in its representation in children's ideas creates awareness of the continuity of relationship, then we also must believe that young children cannot represent in their ideas a central reality of their lives. Children are accompanied unconditionally—by human relationship. Biological relationship and kinship do not keep family together, but children remain accompanied because their instrumental dependence requires human response. They can't do without us. Family relationship is a fact of their lives—despite Piaget's confusion that logic—its representation in ideas—is the telling marker of human knowledge.

The second confusion of idea and fact that social cognitive psychologists have fostered lies in the study of perspective in relationship. One characteristic of children's thinking that Piaget described is the egocentricity of thought. Egocentricity, Piaget suggested, implies that young children are fixed on their own perspective. They have difficulty distinguishing what they think from what others think. Perspective, in Piaget's view, has a very narrow meaning. He defines perspective in relationship as a point of view or idea. In studying social awareness, researchers focus on how the perspectives interact: the other person's idea—what he or she is thinking, and the child's idea—what the child is thinking.

The egocentric child, limited to his or her own perspective, according to this Piagetian approach, brings a very insular and self-absorbed understanding of what people do to and for each other in relationship. This is the interpretation social psychologists make based on Piaget's conception of perspective as the child's ability to take the other's idea or attitude. In social experience children are conceived as primarily concerned with the self and as not very skilled in understanding others' wants, needs, and wishes.

I return to the family data to demonstrate how this narrow definition of perspective as the taking of the point of view of the other person has compromised what we think children know about relationship. In analyzing the conceptions of family data, I have defined perspective as a possible location of self and other in the activity of relationship: in the giving, receiving and sharing between self and other that is relationship. Using this definition of perspective, there are at least six possible perspectives or locations of self and other: self giving to other, self including other in subjective awareness, other giving to self, other and self sharing, self focusing on self in relationship, and self excluding self to focus only on others. In the family interview data, children see all six perspectives.

Here are some examples of the perspectives of human relationship that I have observed.

A first grader is asked:

"WHAT SHOULD PEOPLE DO FOR THEIR FAMILIES?"
"They should be nice to each other."

"WHY IS THAT IMPORTANT?"
"Because they love each other and they should not hurt each other, because someone could die."
"WHEN YOU SAY 'LOVE', WHAT DO YOU MEAN?"
"It means that you can hug them or kiss them, or something like that."

Another first grader seeing another perspective of self and other says:

"WHAT SHOULD FAMILIES DO FOR THE PEOPLE IN THEM?"
"On Valentine's day they give presents to people they love. Presents, birthdays come up too. They should spend a lot of time with them. Because they like each other. They love people. They really care for their auntie or their sisters, for their mom and cousins."

A second grade boy:

"WHAT SHOULD FAMILIES DO FOR THE PEOPLE IN THEM?"
"Be nice and care for one another."
"WHY IS THAT?"
"Because one might get hurt and if you don't care for them, then they might, it might increase and go all over."
"IT MIGHT INCREASE AND GO ALL OVER?"
"Yeah, like yesterday I fell in the sandpit and I got shaky because I was getting all sorts of sand going down my shirt. And then my mom came running down to help me. I had to take off my jacket and get all that sand off."
"SO WHAT'S THE MOST IMPORTANT THING?"
"Care for everyone and care for everybody."
"WHY SHOULD THEY DO THAT?"
"Because if you don't care for anybody, they won't like you and then if you get hurt, they'll just leave you right there, if you get hurt, and you might even have a broken leg."

And finally a first grader taking one of several possible perspectives of self and other in giving, receiving and sharing:

"WHAT SHOULD FAMILIES DO FOR THE PEOPLE IN THEM?"
"They should love them, take good care or help the babies go to sleep."
"WHY TAKE CARE OF THEM?"
"Because then they won't ...I don't think they might have anybody to take care of them."
"WHAT MIGHT HAPPEN?"
"They don't survive."
"IF YOU WERE TO PICK THE MOST IMPORTANT THING?"
"I'd pick that they come along when the person calls them or something. And like when somebody falls down and they call them real bad, they should come."
"HOW COME?"
"To see what's wrong and call the doctor if it's bad bad."

These are representative examples of how children know the six perspectives of relationship.

The perspectives children take in describing the experience of relationship vary. These perspectives are not mutually exclusive. The fact of perspective as a possible location of self and other in the giving, receiving and sharing of relationship is known to them. The perspective can be that of "me giving to you," "you giving to me," "us sharing" or one can take an

insular, me-contained perspective. This last perspective, that of the insular "what's in it for me" approach, is the view Piaget suggested children take in their egocentricity. In fact, young children in the activity of relationship take many different perspectives of self and other, locations of self and other. Perspective, narrowly defined as the "other's point of view," does not capture children's recognition of this fact of the interplay of the perspectives of self and other in giving, receiving and sharing. When we define perspective as a location or place of self and other, young children do not appear to be insular or self-absorbed in relationship. Rather, they are participants—in the activity of relationship—they know they can respond, receive and share. These experiences are represented in concrete ways in their ideas—but children know they can assume each perspective, that each perspective is a fact of family life.

A second grade boy describes an incident of his response and his kindness to another person:

"Like me once in our class I made two presents for my mommy and my dad and then my mom felt happy when I gave her the two wooden things out of clothespins. I gave her a reindeer and a chair and my mom took them and hung them up on a mirror. I gave them both an ornament with a little snowman on it."

A little girl says,

"I get my mother tea and toast when she wants it. Saturday she was feeling sick and so I went down stairs and got her some food."
"HOW DOES THAT HELP A FAMILY?"
"Well, just to be nice to each other by helping."
"WHAT PART DOES IT HELP?"
"The heart."
"THE HEART OF THE FAMILY OR THE HEART OF EACH OF THE PEOPLE?"
"The heart of the people. It helps to be happy in the family. So everyone would be happy and there wouldn't be any fights, and nobody would be angry."

To focus on the idea of perspective and not the fact of perspective, is to overlook the capacity of young children to be full participants in the perspectives of response, receiving and sharing. Children's ideas about what another person thinks are rudimentary, just as the words they use to define family are simple and concrete. This deprivation of complexity in ideas does not necessarily lead to a deprivation in experience or an impaired capacity to recognize the experience of relationship.

If we believe that Piaget was studying the growth of all intelligence and that logical thought is the best and fullest representation of knowledge, what children know about human relationship: the continuity of family, and perspectives of self and other in the activity of relationship, appears impoverished.

The capacity to think logically does not create experience. The acquisition of ideas about human relationship does not create the unconditional place of human relationship in the life cycle. Perspective as an idea about the other does not replace perspective as an experience of active exchange. The centrality of human relationship is a fact of human dependence that children, who represent their experience in the concrete, notice and know, despite the immaturity of their logic, despite the rudimentary way in which they represent the point of view of another person.

Carol Gilligan (1982) points out that the study of human development by psychologists has been premised on the notion that it is the self that is the constant in the life cycle and human relationship comes and goes. Piaget was very much part of this tradition of seeing the self as the constant, his interpretation of his family data being an example of this. The current data suggest that, from the child's vantage point of dependence, the accompaniment of other people persists as a fact and is a source of sense of belonging that, Piaget notwithstanding, engenders a profound knowledge of human relationship, premised on experience, not logical ability.

Perhaps psychologists need to expand their view of intellectual ability and narrow their vision of the acquisition of logical ability as the cognitive ability from which all else follows. Perhaps Piaget, contrary to his own beliefs, was not describing the growth of a cognitive ability that explains all that children know. Howard Gardner, in his book, *Frames of Mind: The Theory of Multiple Intelligences* (1983), makes this point. The broad application of Piagetian theory to all domains of understanding, may be inaccurate. He says, "Piaget has painted a brilliant portrait of development in one domain—that of logical-mathematical thought—but from there has erroneously assumed that it pertains to other areas, ranging from musical intelligence to the interpersonal domain" (p. 134). The interpersonal realm may be one area where, as Gardner suggests, logical thought may be ill-suited to explain competence.

Children's knowledge of human relationship presents a challenge to psychologists and educators. The challenge is to recognize that what children know about relationship may be richer and more profound than theory and measurement techniques have allowed us to see. We are obliged to understand better the abilities children have that allow them to see the tie between people that keeps us bound to each other, despite physical separation, despite time and place, despite unseemly human events.

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