THE UNIVERSITY OF CALGARY

# ECO-lOGICAL SCIENCE: TOWARDS AN INTEGRATED APPROACH

BY

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A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF
MASTER OF ARTS

DEPARTMENT OF
EDUCATIONAL POLICY AND ADMINISTRATIVE STUDIES

CALGARY, ALBERTA
MARCH, 1992

ISBN 0-315-75197-5

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

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15 April 1992
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ABSTRACT

The major thrust of this thesis is to question the assumptions we have of science, and science teaching. Fundamentally this study asks: "What attitudes should we take in the way we approach the teaching of science?" This question was generated by the realization that the historic focus of science has shifted from science as a method to a belief in science as a sub-culture of society responsible to seek and present the truth, from within its own reality. Perceptions and assumptions about science pervade our culture and thus colour the way we as educators view science and understand its limitations. Naturally, being part of this culture, the teacher plays a significant role in the maintenance of the assumptions we hold of science. However, this research does not intend to point to an alternative conceptualization of science within the bounds that already exist. Rather this study will attempt to question certain of the assumptions we hold of science. This is less a matter of adding another dimension to a structure that already exists. Rather it suggests that there is a need for a fundamental re-thinking of the foundations of the way science is taught in schools and of how science needs to be reconceived.

Beyond simple exposition, the study will attempt to show that the philosophical base of science has been eroded. In other words, we have unwittingly, allowed ourselves to be governed by a particular notion of science and how it views our world.

At the outset the study reveals why there is a need to ask these questions. Specifically, it shows how science has come to dominate our way of perceiving and thinking of significant aspects of our world. Taking this as the central problematic, the study then proceeds to explore way in which it may be possible to recapture a more foundational vision of the place of science in education.

ACKNOWLEDGEMENTS

I am indebted to Dr. John McNeill for his kind and imaginative suggestions and for getting me involved in the first place.

I would like to acknowledge the generosity of the members of my committee, Dr. Mathew Zachariah and Dr. David Jardine for their effort and interest.

I am especially grateful to Dr. Rod Evans who guided me with patience and kindness throughout this study.

Finally, I am especially indebted to Susan Teminsky for her continued support, encouragement, and tolerance throughout the research and compilation of this thesis.

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# INTRODUCTION

> *"It is a supreme irony that we had to leave our planet before we could really see it.* When the astronaut showed us what our world looked like from space, it was as if a mirror had been held up for us to see our reflection. The image of Mother Earth, beautiful, fragile, dancing through space, was shuttled through the electronic communications systems around the globe and lodged indelibly in our minds. ... It is, perhaps, a paradox that it was modern technology, and space technology in particular that allowed this view of Earth to be obtained. But the triumph of that technology was not the putting of a machine into orbit or men on the moon - it was the emotional and philosophical jolt made possible on a mass scale down on Earth. *It was a crucial moment in planetary history that had to come; the technology was necessary to force us to look anew at our home"* (Devereux, 1989:Vii; emphasis added).

What does this text mean to us? What are we to make of all that this text implies? What rings right with this, but more importantly what rings wrong?

Early in my teaching career I was bothered by a continual feeling that what I was doing in my practice of teaching was wrong. This feeling I have discovered is the information, the data, the life skills and the understanding of our world that science gave children. Science seemed to be the way we saw the Earth, the way we drew in art class,

understood and learned to control a soccer ball etcetera. It seemed that before one could draw or play soccer the teacher or coach tried to explain the science of color or the science of soccer training to us the students. Our perception of what was correct revolved around the notions of a science. There was a static sense to what I was doing, if provable within the realm of science, then it was good. As a science teacher it became apparent to me that this "understanding" was somehow wrong, something was amiss not only in science education but in education more generally.

In reading the above passage I remembered 1969, the year of the Apollo Mission. The feelings I remember being associated with that event were that humanity could do anything and that we had entered, as it were, the realm of Gods. There was something present, something that we all could believe in, something we were taught to believe could answer all our questions, that was something to everything. This something, upon reflection was science and technology. I was (and I think most other people were) in awe of this technology, this feat of humanity called space flight. The pictures we all saw on television drove this feeling home that we could do anything. I was sure that this technology was the way of the future. Apollo and the associated technology told me that it was the way. How could it be otherwise?

What is interesting is that as time passed I felt less sure that we were on the right track. I began to doubt the grand scheme of ... ; what? This was my feeling. Still I could not answer the question of what I had difficulty with; perhaps I was making something out of nothing, but if this was the case then I knew that I would grow out of this state, that I would somehow change and all would be once again well. However, instead of the "feeling" leaving it has become stronger and has focused itself in texts such as the one above.

Let me try to be clearer and to do that let us look at the first sentence of the text, "It is a supreme irony that we had to leave our planet before we could really see it." That we had to physically leave our planet in order to see with our own eyes what we live on (what it is we call home) is somehow strange. And yet I believe that most readers would experience in this sentence that same feeling that I felt (and I believe others felt) during that time of Apollo, the power of science. Recent shuttle missions leave us with a similar sense as we view on television not our planet but the <u>representation</u> of our planet. This is where another, more important understanding of the text arises.

The descriptions of the planet we saw from Apollo and from recent shuttle missions make the claim that "we see". The difference is that we are not seeing the actual planet

(ie. the planet underfoot), we are seeing a "representation" of the planet. This may seem trivial since we know it is not "the real thing"(ie. the object itself). However, we make the claim that it is nonetheless the real thing (ie. equally "real"). In other words we speak of these pictures as if they were not "representations" of our planet, but our planet itself. This understanding is deceitful. It is deceitful in part because it suggests that we can understand (ie. come to know) our planet through technology (ie. technologically). The final sentence of the text sums up these ideas most explicitly.

> "It was a crucial moment in planetary history that had to come; the technology was necessary *to force us to look anew* at our home."

Although it is crucial that we look at our home with new eyes, I suggest a humbler notion, namely that we begin to do so by looking at the ground at our feet. However, it is important to realize that this is not simply a metaphorical statement. To really see our planet, to see where we dwell, we must look. What does this mean? There is a distinction between the simple act of seeing, as I look at a coffee cup (in the physical sense) and seeing the cup. To see in the physical sense is to see with my eyes, a telescope, a microscope, or any other instrument of technology, the object. The viewer is able to describe the object in many

ways, measurable ways, but they are not able to touch it, feel it, smell it, experience it. To truly "see" the coffee cup these sensations must also be included. The relaxation that accompanies your morning coffee, or your revulsion of that morning cup of coffee. The smell of coffee in the air or coffee beans in a shop devoted to selling coffee. These images are the other half of seeing that we do not (except superficially) accept as part of the act of understanding. This is the deceit. To truly know you need more than science typically allows. You need more than seeing without science, you need more than both. This second manner of seeing (ie. understanding) is left out of our understanding of our world, because it is not scientific. However, to truly see our planet, we must look far beyond the technological sense of seeing if we are to understand where it is we live.

The greatest irony may be that the author of this text does not "see" himself. He goes to great lengths to help us understand something about ourselves and our planet. He claims that the irony is that we had to leave the planet to see the planet. The greater irony is the irony of the supposed necessity of leaving, that we, in leaving our planet saw, but how we saw was with a technological eye, as opposed to the touching and experiencing of the Earth. We do not need to quantify, objectify the planet; the object

itself is here prior to any quantification or objectification.

There is irony embedded in irony in this text and the author's self-understanding of his text. He doesn't truly see the planet. He sees through technology only and this is only one way of seeing. This seeing is showing us that we live there, as on a map at the place where these two lines cross, a technical seeing, not seeing of *my* home, *this* place, *right* here, *where* I live. We begin, in this passage, to walk a path towards thinking that somehow things are not the way they really seem, contrary to the "sense" of common sense. It is obvious that to see ourselves we must rely on others' descriptions of ourselves, or we look in a mirror and see our reflection. It seems that there was a flicker of hope at the beginning of this passage that began a deeper understanding and afforded a different gauging of our place (dwelling) and a different understanding of how we must respond to this place. But this passage fell short; the author tried to look at our planet from outside the boundaries of science but in the end recalled that science to "prove" his effort. Science was the tool needed to show us how to look, *"technology was necessary"*. In the end the writer was unable to escape the intrinsic power of a Western scientific ethos. This is the central task of the study, namely to suggest how it might be possible to study,

understand, "progress", without the ideas of a dominant science.

Science is deemed to be the only proper method for learning skills and, with few exceptions, the only acceptable method by which to describe learning. Earlier I said that science seemed to be the way we saw the Earth, the way we drew in art class, understood and learned to control a soccer ball etcetera. In fact it is more pervasive then this. This science also describes how to teach, how children learn, the methods we must use to be right, etcetera. In light of this realization the question I want to follow is: "How should we teach science in schools today"? If we accept the Western notion of science as is, we will never be able to leave the irony of the text and, more significantly, one will never see the irony in the first place. The task is therefore to challenge the power of science. As Burch (1986) puts it we must know the limits of our science, in order to "recall science to itself."

# Chapter I

## INQUIRY: OUT OF CONTROL

*We do not inherit the land from our ancestors, we borrow it from our children*

Author Unknown

### THE BEGINNINGS OF INQUIRY

Where should one begin? With the creation of "All", with the creation of man. J. Bronowski stated that one should consider that man "is not a figure in the landscape, he is a shaper of the landscape" (Bronowski,1973:19). The world view and value system derived from the attitude of "shaper" is one of the foundations of our Western culture. This attitude must be carefully examined.

The way people pictured their world changed dramatically between 1500 and 1700. Before 1500 an organic world view was dominant in Europe, as well as in most other civilizations. People lived in small, tightly knit communities and experienced nature in terms of organic relationships. Aristotle and later the Church provided the scientific framework for this organically based culture until the thirteenth century. During the thirteenth century Aristotle's system of nature was combined with Christian theology and ethics. This medieval science was based on faith and reason. The basic intent of this medieval science was to understand the meaning of things rather than to

predict and control as our modern science attempts to do. The sixteenth and seventeenth centuries had a radically different notion of the world from that of an organic, living, and spiritual universe to the world as machine.

The inventions of man from age to age allowed man to remake his environment as a result of which a different evolution - not biological as Darwin suggests but cultural evolution - took place. The history of this achievement is what Bronowski has called the "Ascent of Man". In either the biological or cultural evolutionary case there is something missing, something amiss. We have forgotten or misplaced our indebtedness to the natural world and now consider the techniques of science as what we ought to be in awe of rather than being in awe of the world itself.

Francis Bacon saw the world through the eyes of experiment. His influence began a change in the way people thought about their world by attacking the world view of the Greeks. Francis Bacon saw Greek science to be lacking clarity because their science was not derived from experiment. In contemplating nature, the Greeks tried to understand why things in their environment existed the way they did. The Greeks described matter as particles moving through space. However, this movement of particles was explained as being spiritual in origin. Greek philosophy drew a clearly defined line between spirit and matter

turning their attention to spiritual matters, rather than material matters. In later centuries this image of matter as particles became an essential element of Western thought and of the dualism between mind (spirit) and matter (particles), between body and soul, between the metaphysical "why" of things and Bacon's material "how" of things. As Rifkin (1980) put it: "Now the true and lawful goal of the sciences is none other than this: that human life be endowed with new discoveries and powers". This new method Bacon formulated was the beginning of modern science. This new method attempts to separate the observer from the observed and the knower from the known and provided the user a neutral forum that is free of subjective thought, in other words free to develop so-called "objective knowledge". It was a knowledge that Bacon claimed would allow people to take command over all things natural. The image of Mother Earth was radically changed in Bacon's writings with the metaphor of world as machine. This change in world view was developed further by the thinking of such scholars as Rene Descartes and Issac Newton and others.

## THE WORLD AS MACHINE

At the age of twenty-three Rene Descartes experienced an illuminating dream that was to shape his life. In a sudden flash of intuition he perceived the foundation of a

science that promised to unify all knowledge. This view of nature was based on a fundamental division of nature into two separate and independent realms; that of mind (res cogitans), and matter (res extensa). This Cartesian division allowed scientists to treat matter as dead and completely separate from themselves, and to see the material world made up of a plethora of objects assembled into a huge machine. This new science implanted the firm belief in the certainty of scientific knowledge.

> "All science is certain evident knowledge, we reject all knowledge which is merely probable and judge that only those things should be believed which are perfectly known about which there can be no doubts" (Descartes cited in Capra, 1982:57)

Descartes' famous sentence "Cogito ergo sum" has led Western thought to equate identity with mind instead of with the whole organism. Descartes reduced all quality to quantity and introduced the possibility of a world in which only space and location mattered. This Cartesian division has people aware of themselves as isolated, separate, existing inside their bodies as if their body was simply a container to hold the "mind". The mind is treated as conceptually distinct from the body and given the task of controlling it. One consequence of the belief in this Cartesian division is that it has alienated us from nature and in some respects from our fellow human beings.

Descates' division of mind and body coupled with Newton's construction of classical mechanics based upon this division has dominated scientific thought for the last 300 years. This belief is still widespread today and is reflected in the scientism that has become typical of western culture. Some scholars have seen a link between this "scientism" and the modern economic order.

> "It has brought a grossly unjust distribution of natural resources creating economic and political disorder; an ever rising wave of violence, both spontaneous and institutionalized, and an ugly, polluted environment in which life has often become physically and mentally unhealthy" (Capra, 1975:24-28).

The knowledge that science has given us can now be seen as a crisis of life in the world.

## THE COMMON WORLD

The object world and all that surrounds us can be called the natural world; the world of plants, animals, soil, etcetera. The human world (as opposed to the natural world), is in Hannah Arendt's words the common world. She divides this human world into a common realm and a private realm. The private realm belongs to each person and is the part of our existence that does not carry on from generation to generation, it terminates with each person's death. The private realm is our self, our memories of things and

people, it is in a true sense the mortal part of our life, the mortal part of each person. The common world, on the other hand, is made up of all the institutions and cultural artifacts etcetera, that survive the death of every individual. The common world encompasses past, present, and future generations. It is what

> "... we enter when we are born and what we leave behind when we die. ... It transcends our life-span into past present and future alike; it was there before we came and will outlast one brief sojourn in it. It is what we have in common not only with those who live with us, but also with those who were here before and with those who will come after us. ... Without this transcendence into a potential earthly immortality, no politics, strictly speaking, no common world, and no public realm is possible." (Arendt cited in Schell, 1975:115-119)

In the common world knowledge accumulates through our collective memory of the physical and social world. Over generations this knowledge provides the human world with the knowledge that we have existed and progressed,(ie. our history) from the past to the present. This progression can be seen as a natural event that is part of the natural world as all things have a past. The knowledge we have of our history also provides a threat to the natural and humanly constructed world. This threat is the accumulation of knowledge gathered throughout the ages that provide the human world with the knowledge to extinguish itself. If there is a threat it is because we know about our past, that

there was a past. If we did not know that there was a past this progression of historic knowledge would not exist and therefore not be a threat. We simply would not know that there were others before us and we would always have to rediscover what was before us. Imagine if no stars were present in the night sky. With nothing visible to wonder at (ie. the stars) would space travel ever have been contemplated? If we did not know of our own history our collective immortality (our extinction) would not be seen as the end of life.

> "If mankind had not established a common world, the species would still outlast its own individual members and would be immortal, but this immortality would be unknown to us and would go for nothing ... and the generations, unaware of one another's existence, would come and go like waves on the beach, leaving everything just as it was before." (Arendt cited in Schell, 1975:118-119)

This knowledge of our history is therefore part of our common world (our history), and our actions and the knowledge we hold of our past impact the status of the common world and its natural foundations. Because of the common world we know of other generations and the terrestrial nature of which we are part.

Bacon's science and Descartes' mathematics in one single stroke eliminated everything in the world which may be thought of as messy, chaotic, and alive. Science is seen to be "clean", free from all matters of judgment relying

solely upon the quantifiable mathematical nature of our world. This science was tasteless, colourless, and odorless, all things reduce to their simplest form such that the variation present in all things is effectively removed. This variation, however, is the key suggesting that things are not that simple, life is not unambiguous, controllable, predictable. Science, as seen through technology, has created a sense that knowledge permits us to know and therefore control nature. This clean character of science suggests that solutions to any problem can be had if given time; therefore all problems are in principle conquerable and not beyond our eventual control.

The mechanical age has been characterized by the notion of progress. Reduced to its essence, progress is the term used to describe the process by which the less ordered natural world is harnessed and transformed into the ordered material world. As Rifkin (1980) states; "Science ... is the methodology by which people learn the ways of nature so that they can reduce them to consistent principles or rules" These current beliefs and values are compromising the very systems that keep us alive. Jardine (1989) writes of the need

> " ... to turn us away from our idealized and admittedly beautiful and seductive edifications and grand theories, and back to life as it is actually lived. ... All around us is the urgency. For the ecological

> consequences of believing in our own dominion are accelerating and threaten to suddenly trivialize all our earnest theorizing and demonstrate to us full force that we are not worldless, self-present subjects who can live in the rarified atmosphere of Descartes' dream" (Jardine, 1989:15-16).

## FRAGMENTATION: THE BEGINNINGS OF OBJECTIVISM

The people of the 15th and 16th centuries held the view that the earth was a living creature. By the end of the 17th century "educated" people were certain that the planet was merely a lump of dead matter. The mechanistic philosophy and the quantitative measure of matter and motion explained fully all the properties of any substance (Devereux, 1989:41). This mechanistic philosophy is the way we have tried to understand our world and this method, this approach, is our peril.

"We do not inherit the land from our ancestors, we borrow it from our children." This simple thought clearly places a certain priority upon how we <u>ought</u> to view our world and our place in the world. Our children and children's children can learn through us (the past) how to understand the land. As we teach our children we do so in the present (at this moment) but teach of the past since we are always representing knowledge, interpreting knowledge, that we as teachers have already reflected upon. We fall short of understanding that a future does more than

potentially exist (ie as a full range of open possibilities) but is shaped by our action or lack thereof. The common world is unharmed by individual death but depends on the survival of the species. This common world is now in jeopardy by our own understanding of what science is able to accomplish through technology. As Capra (1982) points out "Many people in our society, scientists as well as non-scientists, are convinced that the scientific method is the only valid way of understanding the universe." We see science as the light at the end of each problem we face. However, as Jardine (1989) points out, this means that the original kinship with the Earth has been lost. The clarity achieved through science has turned its back upon the Earth as a weapon of domination.

Our desire to survive and the fear that we may be slowly destroying ourselves forces us now to make decisions that are often seen as radical. Because of our faith in a particular definition of "science" our decisions are based upon the objective understandings of our planet.

> "The Earth is one but the world is not. We all depend on one biosphere for sustaining our lives. Yet each community, each country, strives for survival and prosperity with little regard for its impact on others" (Our Common Future,1987:27)

As a consequence of our emphasis on reductionist thinking our culture has developed profoundly unhealthy

unhealthy lifestyles. As a consequence, our consumerism has given us a prepackaged existence that has polluted the air, water and land. A fragmented world view is also an unhealthy view since there is a close connection between health and whole. To be healthy is to be whole, in a sound or wholesome condition, free from disease, healthy. The mechanistic world view has reduced our world to an infinite collection of parts, rather than a whole and then asks for reasons of how things work. However, it seems that our world is complete (whole) requiring no outside (ie. extra-terrestrial) assistance to life. All that is required is located upon this planet. Our view of our world as it exists today is a fragmented unhealthy view. We see ourselves living on a small planet on some continent, in some country, state, province, city, neighborhood. This perception of our planet as fragmented gives reason for the maintenance of man-made divisions that somehow separate us from each other. It can be said that pollution knows no bounds, yet borders are seen as artificial barriers to the realities of the planet as a whole. This perception objectifies the understanding of our planet so that we no longer talk of our world but a geographical representation of that world (ie. this country or that place). This idea needs to be thought through. Descartes' phrase "a substance is that which requires nothing but itself in order to exist"

further fragments all things such that the atoms are now only objects isolated from the very structures they generate. This science separates us from our world by telling us that we are as the atoms, separate from our world, not a part of it. This view cannot be one we would want to claim, yet it seems that this separation exists today since our planet is described to us as nothing more than a substance.

> "Everything changed in 1969. This was the year in which ... for the first time [we saw the] Whole Earth. We knew the world was round, of course, but to see it for ourselves was somehow different . . ." (Devereux, 1989:vi).

We did not "see" for ourselves the planet earth. We saw for ourselves a representation produced by a camera changed into electrical pulses that are transmitted to be re-broadcast to us and viewed on our television screens. In fact we were further from our planet than the astronauts who did see, did experience that vision of the planet. Our view was at best a representation of the planet, a further fragmentation and objectification of our world. This idea of not seeing our world as a whole is picked up by Wendell Berry such that if a farmer fails to understand what health <u>is</u> his farm becomes unhealthy. Just as if we do not understand what health <u>is</u> in a global sense, our world becomes unhealthy.

> "... not only is fragmentation a disease, but the diseases of the disconnected parts are

> similar or analogous to one another. Thus, they memorialize their lost unity, their relation persisting in their disconnection "(Berry, 1986:110).

This fragmentation and this isolation creates a picture of inquiry as out of control; inquiry does not "see", does not know the ground it travels, it relies upon; inquiry covers the ground with an understanding of things as pieces, each separate and distinct from the other.

> "... no longer does human life rise from the earth like a pyramid, broadly and considerately founded upon its sources. Now it scatters itself out in a reckless horizontal sprawl, like a disorderly city whose suburbs and pavements destroy the fields" (Berry, 1986:21).

RECAPITULATION

In this section I have tried to show the development of modern thought from an historical perspective. This historic understanding is fundamental to this study since to know where to go you must know where you have come from. The chapter is an attempt to show that there are other ways of viewing our world than the scientific as developed by Francis Bacon, Rene Descartes, Issac Newton and others. These other impressions suggest that "something" has been lost in our understanding of science and therefore of science teaching. I refer to this "something" as a concern for understanding and reflecting on where and what we are.

# Chapter II

## THE NATURE OF INQUIRY

*It is a curious fact that just when the man in the street has begun to believe thoroughly in science, the man in the laboratory has begun to lose faith. When I was young, most physicists entertained not the slightest doubt that the laws of physics gave us real information about the motion of bodies, and consist of the sorts of entities that appear in the physicists' equations.*

Bertrand Russell

### FROM THE SIDE OF SCIENCE

Science is a complex enterprise that essentially consists of two inter-dependent episodes, one imaginative or creative, the other critical and systematic. The starting point of scientific inquiry is the formation of hypotheses. To have an idea, advance a hypothesis, or suggest what might be true is a creative exercise. But scientific hypotheses must be capable of being subjected to critical examination and empirical testing. The process of science is most often characterized as a process of invention or discovery followed by validation or confirmation. One process concerns the acquisition of knowledge, the other concerns the justification of or for knowledge. What distinguishes science from other forms of knowledge such as metaphysical, is the process by which knowledge is justified or validated, not the process of invention or discovery.

Whatever science is, its identification as "organized knowledge" illuminates but one of its elements. The collective knowledge, which is one of the products of science, has a dynamic counterpart, the process of science. Science is both a kind or type of knowledge and a way of gaining and using that knowledge. Real science is both a product and a process, inseparably joined. (Kuslan & Stone, 1968:2) James B. Conant (1947) described science as "an inter-connected series of concepts and conceptual schemes that have developed as a result of experimentation and observation, and are fruitful of further experimentation and observation."

Man's mastery of nature, imperfect though it is, did not arise out of the magical incantations of primitive medicine men, but out of man's endeavors to understand the order of nature. Power over nature comes from this understanding and therefore, a type of knowledge which leads to higher and more embracing levels of ordered knowledge is one goal of the scientist.

Science is much more than a collection of facts and formulas, it is pre-eminently a way of dealing with experience-mainly by negating it. Science is a way of behaving, a way of interpreting reality, rather than as an entity in itself, as a segment of that reality. "Science is a kind of human behavior" (White, 1969:2). Will Durant

discusses the relation of science to philosophy as a window through which philosophy sees the world. The sciences offer themselves as the senses through which philosophy sees the world; "without it knowledge is as chaotically helpless as sensations that come to a disordered mind, making an idiot's lore"(Durant, 1941: 12). Philosophy without science is impotent, but science without philosophy is not merely helpless, it is destructive and devastating. In the traditional view science is purely descriptive. It looks out with eye, microscope, telescope, and tells us what it sees; its function is to observe carefully the fact(s) at hand, and describe it objectively and accurately, regardless of the results to man.

Traditional accounts of science describe the attainment of "mature thinking" as the result of some sort of progressive "mental" development. Comte (1853) taught that intellectual development starts with a theological phase, passes through a metaphysical phase and culminates in the positive or scientific phase. Scientific thinking, at least when it is at its best critical level, is distinguished by the virtues of intersubjective (objective) testability, of a high degree of reliability, of definiteness (or precision), of coherence (or systematic structure); and of comprehensiveness (or scope). Magical, animistic and mythological ways of thinking lacks one or more of these

characteristics which are essential, or at least highly desirable for the attainment of the goals of scientific knowledge: adequate descriptions, explanations, and predictions on the basis of the facts of experience.

FROM THE SIDE OF ECO-lOGICAL SCIENCE

Jonathan Schell (1982) describes science and scientists as bees working harmoniously to construct a hive of great complexity that grows more elaborate and splendid as each year passes.

> "So durable is the scientific edifice that if we did not know that human beings had constructed it we might suppose that the findings on which our whole technological civilization rests were the pillars and crossbars of an invulnerable, inhuman order obtruding into our changeable and perishable human realm. It is the crowning irony of this lopsided development of human abilities that the only means in sight for getting rid of the knowledge of how to destroy ourselves would be to do just that - in effect, to remove the knowledge by removing the knower"(Schell, 1982:103).

Many parts of the Third World are caught in a downward spiral: people are faced with having to overuse their environmental resources to survive from day to day, and the impoverishment of their environment further impoverishes them, making their original task of survival even more difficult and uncertain. The prosperity we and others have

attained is often tenuous. This prosperity has been secured through agricultural and industrial practices that bring prosperity (profit and progress) only over the short term. Further, some communities have invested in only one industrial practice while others have invested in many, but the long term effect is still the same: the short-sighted pursuit of prosperity and the accompanying consumerist ideology.

> "The West is defined by its "Ideology". That alone is what sets its boundaries. This ideology, in brief, is precisely development, i.e. in two words, the exorbitant and specific belief in the mastery of nature"(Latouche, 1987:35).

The progress of western civilization has always been dependent on technological ingenuity (i.e. technical rationality) and a capacity for cooperative action. These qualities have been used many times in the name of developmental and environmental progress but today it is clear that this notion of progress is no longer good enough. If science holds the key to our dilemmas then this "technical rationality" becomes legitimate, however the economic and natural interconnections of our world bind us. This is therefore the key question: does science hold the key to solving the world's dilemmas?

> "... given the deeply consumptive desires of the North American culture, given the ecological horror left in the wake of Descartes' nightmare, we may be standing at the moment of the degenerativity of humanity. ... Only in the midst of non-action, attending, waiting, does action become exquisite. Only in the midst of silence does the word ring out as something that might call out for attention. Heeding this image of inquiry as obedience and thanksgiving, and considering the way it raises the question of our place on the Earth, offer, not solace and romantic visions, but a moment of pause in the din of the newest and the best in educational theory and practice" (Jardine, 1989:34).

As Hannah Arendt points out, we educate for a world that is always on the verge of disaster. This is the basic human situation. Our modern world has been created by mortals to serve mortals for a limited period of time. Because this world has been created by mortal hands it wears out; the world is continuously changing inhabitants as children replace the aged that have left. This continual cycle of change puts the world at risk of becoming mortal itself. To preserve the world against the mortality of its creators and the inhabitants of the world, the world must constantly be set back on course, back from the verge of disaster. The problem is, therefore, how to teach the inhabitants in such a way that setting right is actually possible, even though it may never be assured.

> "Our hope always hangs on the new which every generation brings" (Arendt cited in Schell, 1982:103).

And again:

> "Education is the point at which we decide whether we love the world enough to assume responsibility for it and by the same token save it for the coming of the new ..." (Arendt cited in Schell, 1982:103).

If we find this permissible then why do we believe that educational theory should be subject to the standards of the natural sciences? Why, therefore, should teachers of science, in fact any teacher feel that their efforts should be subject to the standards of the natural sciences? There are three basic reasons for these feelings and attitudes. The first is simply that this is the way science has always been taught. The second is that the teacher has been taught that this is the way-of-science. The third and most important is because what the teacher is teaching is precisely what we call "natural science" so it seems only reasonable that the "teaching" of science also conform to the demands of the topic (science). The problem inherent with this is that in any case the justification of the belief regarding the nature of the teaching stems from the philosophy of the discipline in question, namely science. In each case science holds the user, in this case the teacher, as hostage since to question your belief from your belief is at best folly. To question what you belive you must "return" to it from *outside the realm of the system of thought that conceived it.* Science is seen as the creator

of our brave new world. Science presents this new world to us (with concepts and new methods which have altered our civilization and our society) as a "better" world. Inalienably, this science also perceives its creators, humanity, in a new light that affects the meaning of all we think of and consider important. This view of science has been accepted by our culture in everything we do. It presupposes that the "scientific" teaching of science is a beautiful and wondrous thing, forgetting those who consider our scientific age an unmitigated disaster in many ways.

A new way of understanding science is needed in our culture today. The blind acceptance of what science is able to inform us of is no longer, if it ever was, sufficient.

> "To successfully advance in solving global problems, we need to develop new methods of thinking, to elaborate new moral and value criteria, and, no doubt, new patterns of behavior. Mankind is on the threshold of a new stage in its development. We should not only promote the expansion of its material, scientific and technological basis, but, what is most important, the formation of new value and humanistic aspirations in human psychology, since wisdom and humanness are the 'Eternal Truths' that make the basis of humanity. *We need new social, moral, scientific, and ecological concepts, which should be determined by new conditions in the life of mankind today and in the future.*" (I.T. Frolov Editor Communist Magazine. emphasis added, WCED Public Hearing, Moscow Dec. 8, 1986.)

The concerns for science education are reflected in the changing curriculum content of schools in various countries.

One question seems not to have been addressed: are the changes real or simply new names given to what already exists?

## THE THEORY OF THE NATURAL SCIENCES

In the natural and social sciences method is the means used to convince others of some point of view. Campbell and Stanley, for example, claim that social scientists must justify experimentation "... not as a panacea, but rather as the only available route to cumulative progress" (Cited in Barritt et al, 1983:23).

The nature of our understanding of science needs to be the turning point. We do not want to continue to teach science as it is currently taught, since to do so would not give us a new sense of science only a new cover holding the same science. What must be discovered, perhaps, re-discovered is what science ought to be, or even better, what it could be. This is my central claim once more, something has been forgotten in our understanding of, and thus our teaching of, science. As Jardine (1988) suggests, the integrated approach is, at its roots, an ecological matter, perhaps even a spiritual matter. This can make possible vastly different images that involve the way we perceive our place or the place of our children on this Earth. Questions arise concerning how we are to comprehend that we are all of

this Earth and therefore involved personally in the fate of the Earth. What choices can we make concerning our Earth since to overstep the constraints to which we are all bound we may push our Earth beyond what is possible to sustain it.

The mechanical world view of mathematics, science and technology, the modern world view of materialism and progress, the world view that claims to offer explanations of the world we experience, is beginning to lose its validity and its appeal.

> "All inductive arguments in the last resort reduce themselves to the following form: if this is true, that is true: now that is true, therefore this is true. This argument is, of course formally fallacious. Suppose if I were to say: If bread is stone and stone were nourishing, then this bread will nourish me; now this bread does nourish me; therefore it is stone, and stone is nourishing." (Russell, 1961:622)

To advance an argument like this would undoubtedly be thought of as foolish; however, it is not fundamentally different from the argument on which all scientific laws are based. Similary a scientific law may be defined as a theory or explanation which has been extensively tested and found valid or true. Scientific laws by their nature are "no more or less than a careful record of what actually happens, therefore there is no possible way of violating it" (Kemeny, 1958:38).

Several things are necessary if we are to change the current domination of the scientific view in education as well as other fields of endeavor. In countering the disposition of "technical rationality", phenomenology and hermeneutics are especially important.

## EDUCATION AND PHENOMENOLOGY: AN ALTERNATIVE APPROACH

Phenomenology is mainly a philosophy of intuition. Unlike the scientist who sees intuition as an unreliable source of information or knowledge, in phenomenological discourse intuition does not suggest any mystical overtones, rather it denotes a manner of seeing and grasping the nature of any given phenomena. In other words it has to do with the way we attend to that which offers itself to our awareness as immediately present. Phenomenology is not concerned with external or internal facts

> "...it leaves the question of, objectivity, object reality or of real context aside in order to turn its attention solely and simply on the reality in consciousness, on the objects insofar as they are intended by and in consciousness ... "(Heidegger, 1977:82).

We see, for the most part, what the language of our minds allows us to see. As Heidegger describes,

> "Phenomenology neither designates the object of its researches nor is it a title that describes their content. The word only tells us something about the how of the demonstration

> and the treatment of what this discipline considers" (Heidegger, 1977:82).

In phenomenology we are being asked to get away from some of the traditional concepts to ones that correspond to our lived experience of the world. The idea is to return to "the things themselves" (the phenomena) and make an objective inquiry of that which of itself is manifested in consciousness. To allow the phenomena to reveal itself the individual must adopt the attitude of "letting be" rather than imposing one's preconceived, theoretical constructs upon the phenomena, which often cover them over, hiding them from view. This does not mean being indifferent to the phenomena or refusing to speak, although it can be true that conceptual language tends to obscure the living quality of phenomena. Conceptual language tends to speak to the activities that surround an activity but not the activity itself. For example, the <u>way</u> we teach is often mistaken for <u>teaching itself</u>, the action is often assumed to be the same as the phenomena. As a consequence we often tend to speak about the "concept" of teaching as the activities that surround it. To "see" the phenomena is to see through and by means of language. The descriptive language used in phenomenology must be as free as possible from any preconceived conceptual categories. This is the first and most difficult task of phenomenology: to distance oneself

from the conceptual attitude and from the dominance of preconceived ideas and opinions.

Paramount to this study is the question: "What does the phenomenologist "see" when he looks at education, specially science education?" To begin with most people would agree that education as an experiential phenomenon does refer to some concrete happening, something that is real and meaningful for a particular individual. Any experience that appears to consciousness must qualify as a phenomena, and in ordinary language it is not uncommon to speak of an educational experience; therefore, "the experience of being educated" must also be a phenomena. It is important to note that "the experience of being educated" is our focus, not "education" as an abstraction of some kind. This is because we are looking at something that happens to us, something that addresses us in immediate consciousness. In order to allow the experience of being educated to manifest itself in itself we must free ourselves as much as possible of any and all preconceived notions of education.

Further, one must not succumb to the temptation of a superficial, naive seeing of the phenomenon. A phenomenological analysis and description is not a simple "just describe it as you see it." On the contrary, to view things phenomenologically is to see things in a radically new way that demands rigorous, disciplined attention to the

phenomenon. Rather than a naive, simple description based on a superficial "that's the way I see it," a phenomenological analysis and description is often necessary precisely because the phenomenon in question is hidden (concealed) from view. The idea of the natural attitude is a clue to an appreciation of phenomenology. Husserl (1962) describes this attitude;

> "I find continually present and standing over against me the one spatio-temporal fact-world to which I myself belong, as do all other men found in it and related in the same way to it. This 'fact-world', as the world already tells us, I find to be out there, and also take it just as it gives itself to me as something that exists out there. All doubting and rejecting of the data of the natural world leaves standing the general thesis of the natural standpoint, 'The' world is as fact-world always there; at the most it is at odd points 'other' than I supposed, this or that under such names as 'illusion,' 'hallucination,' and the like, must be struck out of it, so to speak; but the 'it' remains ever, in the sense of the general thesis, a world that has its being out there. To know more comprehensively, more trustworthily, more perfectly than the naive lore of experience is able to do, and to solve all the problems of scientific knowledge which offer themselves upon the ground, that is the goal of the natural sciences of the natural standpoint" (Husserl, 1962:96).

The "how" of the educational phenomenon, the fact world, is what must be made clear. This question is not being asked within the context of the everyday world, nor the scientist's world where the attitude of 'the natural world' prevails, but in a pre-thematic level of lived

experience. This is prior to the scientist's world and one stage removed from the original datum, the phenomenon. This "how" is a more basic pre-predicative "lived world" where the phenomenon just appears. The concern here lies with describing the phenomenon as it appears in itself, in its deep structure or "being" aspect, not according to the dictates of scientific inquiry where the primary concern is with the empirical or "factive" nature of the object or phenomenon.

> "The question of being thus aims at an *a priori* condition of the possibility not only of the sciences which investigate beings of such and such type -and are thereby already involved in an understanding of Being; but it aims also at the condition of the possibility of the ontologies which precede the ontic sciences and found them. *All ontology, no matter how rich and tightly knit a system of categories it has at its disposal, remains fundamentally blind and perverts its innermost intent if it has not previously clarified the meaning of being sufficiently and grasped this clarification as its fundamental task*" (Heidegger, 1977:54 emphasis added).

To see things in the light of an ecological science it will be necessary to refocus our thoughts on a different, deeper level than we are accustomed. One must break through the common ordinary world of the natural viewpoint, which is the basic world of science, to the deeper level of "phenomenological essences" where we focus not on the re-constructed object but on the pre-reflexive act of seeing,

not on education as "object" but on the experience of being educated, not on science education, but on the experience of being-educated-scientifically. As Husserl explains, seeing (education) phenomenologically is seeing (education) as lived. The difference is not something that can be proven deductively or demonstrated "logically" but is something that can either be seen or not seen. It takes considerable effort to see the phenomenal world as distinct from the natural world of objects. It is common, in fact one of the main theses of this study, to ask and answer all of our questions within this attitude of the natural view point, the ordinary common-sense world of objects that we see in the natural world "out there". To ask the question: "Where does the educational experience appear, or the science educational experience appear", most people would respond: "In the classroom or laboratory". The more sophisticated response may be: It appears because of certain antecedent factors or conditions or within an "educational" context. An educational experience occurs as a response to certain stimuli or because someone is at that level of understanding. In the ordinary world of natural objects governed by the laws of cause and effect the "how" of a phenomena becomes the how-come or why? The real question, however, is not how-come or why but "how" in the sense of "in what manner or way" does the phenomenon of being

educated, being educated scientifically, appear. To know, to see the apparent univocal (having one meaning only) nature of our education, science education in particular, is that we must attend to a prior form or type of knowing before we can be educated scientifically; we must know where to "look" and how to "see". To attend to this question requires a radically different mode of "seeing": that of eco-logical science.

## ECO-lOGICAL SCIENCE

Instead of a preoccupation with "the scientific method" and its form of linear thinking, other perspectives and values are becoming "essential" today. A hermeneutic dialogue involves the questioning of "received wisdom and notions of common sense" (Beyer, 1987:28). There is a wonder for mystery, the unknown, the barely describable in a hermeneutic dialogue, that will begin to re-energize our thinking and return us to a less dominant position. No longer will we "know" something as simple <u>fact</u>, that is generalizable, because all the interconnections between the object and the life world will not have been removed. The object of our curiosity will still be in-tact.

This repudiation of "technological rationality" also implies a rejection the major tenents of political and social philosophy. Knowledge today is embedded in

appropriate isolated experts. As typically understood, knowledge is something that can be quantified and accumulated, but the answer to questions is located not in the knowledge but in the expert who has acquired the knowledge. The rejection of technological rationality,

> "... carries with it both a humanizing and democratizing of knowledge and an individual and communal responsibility for action" (Beyer, 1987:29).

Knowledge as it exists today is largely meshed within political, social and ideological contents such that the pursuit of knowledge is sought for its own sake. Knowledge is typically regarded as that which works towards the solution of social realities and material problems. The aim of eco-logical science, of phemonenological-hermeneutics is not the achievement of pre-specified outcomes that are somehow rationalized and sequenced, and "individualized", but the study of experiences, to reveal the possible meanings of experience, to re-call common sense to itself, to understand the ordinary meanings of everyday life.

Admittedly, this is a rather abstract discussion. To look for the phenomenon in immediate everyday experience, in science class, might go like this: If you asked a child what is "that"?, he might say, "That's the stuff we (class) used to help indicate the presence of starch, right?" For the teacher that is an answer that has a host of interesting

meanings to be reflected upon perhaps more than once. Has the child answered the question with an understanding that is sufficient for today? Has the child spoken to other meanings that may be important? To the student that would be the beginning of a phenomenological analysis of the phenomena of that indicator, the doing of eco-logical science. The iodine used as the indicator is more than that; its description includes the meaning of "the stuff mom put on our cuts and damn did it hurt". No longer is there a once-and-for-all-times certainty about things. Something else is clearly central to this alternative view of science, and of science teaching. Eco-logical science does not seek to avoid confusion nor does it flee ambiguity. Eco-logical science seeks interpretation, we want variation so that we are able to extend ourselves. Our extension (i.e. growth) is the change in our confusion as we move from one confused state to the next, (not a forward, or linealy sequenced movement necessarily). Yet, this movement, this change <u>is</u> our learning. We do not end here but begin the questioning again. This is not logical, so much as eco-logical.

## RECAPITULATION

This chapter presented three basic ideas. The first idea discussed was the description of science as it sees itself. The nature of scientific inquiry from the side of

science was discussed: science as method, as behavior, as vehicle to knowledge.

Secondly, an introduction to non-scientific inquiry was presented. To accept, even conditionally, this notion, different questions must be asked. This was recognized as the first difficulty we have since it begins to counter what it is we have been taught to believe, and suggests this belief is incorrect, misplaced. Also the suggestion that phenomenological-hermeneutics is mis-placed stems from the idea that only scientifically controlled investigations have rigor. This beginning is needed in order to introduce the ideas of phenomenological inquiry as an alternative to traditional science.

The third and final section consisted of a discussion of phenomenology and education. This is a critical topic to this study. A portion of this work converses with ideas of what is meant by education and what is meant by science education. This discussion is not superficial to the study but is fundamental to the thinking of the study. To study science from outside the conventional boundaries of science is a difficult conceptual jump, but is the starting point, the turning point of this study. This is where we leave the world of the scientist, where the "attitude of the natural world" prevails, in order to turn towards a pre-thematic level of lived-experience.

# Chapter III

## THE QUESTION OF APPROACH

*The world's darkening never reaches to the light of Being.*

Martin Heidegger

The question this research is attempting to understand is a question of meaning: what does it mean to ask questions? What is the meaning of inquiry? From the point of view of understanding the "method" (ie. the attempt to find understanding) certain difficulties are uncovered. Firstly there is a problem in asking a question that asks for the "meaning" of something or even that "an answer" could in fact be found that goes somewhat beyond mere personal subjectivity. I hope to be able to show in this study that the question of this study is researchable in more than merely a subjective manner. In this short chapter I would like to address certain methodological and epistemological features of the research question.

## THE QUESTION OF APPROACH AND METHOD

There are many means possible in approaching a study such as this. We usually understand method as something that will lead to a series of conclusions generally based upon empirical measurements. Following that a set of generalizations or recommendations will be "created" to give

solace to the reader that "something is being done". The challenge of this study was to re-discover where "the domain of meaning exists" such that questions could be asked and answered without compliance to a predescribed model that often answers the questions before they have been asked. This then is the jumping off point where you have to "relinquish [your] preoccupation with concepts, models, theories and so forth, in favour of "returning to the world" (Husserl cited in Evans,1989:31).

In this study a set of readings or texts will be presented that constitute the data. These readings will highlight positions of the dominant paradigm in educational curriculum, reference works, and general "expert" material. These examples have been chosen in order to illustrate the pervasiveness of science and the scientific perspective in our culture and to show how science has come to represent what we expect as truth. In the process I want to try to show how science has taught us to view issues in isolation, as separate, and as objectified and therefore to look for solutions in a piecemeal way. We have come to believe that for each problem that exists in our world there is or could be a scientific solution for it. If we think carefully we will see how our "solution" is only concerned with the appearance of the problem, not with the problem "itself". We are being lulled into believing that our life-styles need

not change, that somewhere there exists a "quick fix". Recognizing the persistent nature of these troubles might give us the opportunity to change the way we think to a new humble idea, in contrast to our present defiant one.

There is the major difference between this study and most other forms of educational research. There is a tendency to be mistrustful of research that does not use a traditional empirical methodology but instead uses readings and interpretations as a base for research. To analyze data in traditional approaches to research one uses statistics and methodological devices of various kinds and in doing so removes the variation that exists in all things; one removes the life from the data as a dynamic source. The removal of the variation creates data that is static, that is not what is or has been studied but rather a mere abstraction or conceptualization of what is being studied. The fullness of life with all the variation intact is the starting point for this research.

## READINGS AS INTERPRETATION

Reading (the data) may be done as a "weak" activity or as a "strong" activity. Looking at text without interpretation, to take words as they exist, at face value (ie. in a literal manner) is to read in a weak manner and to be non-reflective in our reading and interpretation. To

grasp meaning from the data is what we need to do in order to read the data from a strong position. The question is how to read these data as a strong activity.

In reading from a strong position a question exists: What makes one reading better, more meaningful, than any other reading? How are we to "unpack" meaning from text?

First, the meaning of text is determined by the intent of the author, and so reading is the rediscovery of what the person authoring the text meant by it (Evans, 1989:38). This seems to be exactly what one ought to do, and in fact why should or why would a reader interpret text differently from the author? There are many reasons this may occur. A person does not always know the full implications of what he or she says or writes. Rarely is one fully aware of all the contextual motivations produced by the text. The author has some goal in mind and may not "see" other lines of thought the text invokes in other readers. Readers develop slants of thought, based on the contextual demands of their reading of that text at that time for a "single" purpose, even though they know that they should refrain from this impulse. An individual reading a passage at an airport waiting for someone to arrive does so with a different purpose even though that particular piece of work may be an important section of a larger piece. The meanings understood from the text are likely to be very different than the understandings

of that same piece back at the office. The context that individual holds at the moment of reading influences the reading such that in the first case reading may only be an occupation of time while waiting, while in the second case the reading may be an effort to edit a piece of work. Where we are, and the particular frame of mind we are in at the moment of reading, affects the reading of a piece of text. Rarely do writers refine their texts in order to disclose their original intentions even if they do they need not necessarily be trusted that their clarifications are commensurate with their original intentions. Frequently an author's intentions are themselves ambiguous and subject to interpretation (Evans, 1989:37-39).

Secondly, no single person is responsible for the understanding of a text, since every reader is a member of a community of interpretive readers, sharing a language, set of conventions, etc. (Evans, 1989:39).

Thirdly, the meaning of a text "is determined by a so-called fusion of horizons between the reader or interpreter and the text" (Gadamer in Evans, 1989:39). This view is to bring one's own historically situated understanding and questions to the text, which the text answers.

## A NORMATIVE READING

To add a normative dimension to reading (interpretation) is to be engaged in the "practice" of a strong reading. To be engaged in a strong reading is to be ethically involved in the readings. Here one cannot remain neutral because to attempt a strong reading calls for maximum subjectivity, for ethical as well as existential involvement thereby recognizing the necessity of overcoming objectivity (Evans, 1989:43). Fundamental to this study is the belief that the acquisition of knowledge, understanding, requires certain attitudes or states of mind. Here knowledge requires not a disinterested or dispassionate attitude "but requires as a fundamental principle of its methodological procedures a certain passion" (Evans, 1989:44).

It is important to make the following clear at this point. There is no claim that the interpretation of these readings (presented in the next chapter) are the only ones possible. There are others that are possible given different interests and circumstances. However, the readings are not arbitrary or meaningless. They are guided by a specific intention, namely that there is no possibility of reading the texts (which in this study constitutes the data) neutrally.

THE APPROACH

The readings that follow in the next chapter were selected for the reason that they are common examples of writing from education, science, economics, popular literature, etcetera. The readings (data) were selected since they clearly show the extent to which science has permeated most of our common-sense sources of information. The thesis of this study could be seen as embedded in the fabric of the readings themselves. One way of seeing science has come to dominate our way of perceiving and thinking of significant aspects of our world. The limitations of this need to be made clear.

It is important to be clear that these readings were not conceived as a way to validate some research finding or create some insight or interpretation of "reality" on my part. Yet it is important not to read blindly. The intentions, purposes, meanings etcetera of the authors are important, but one must not be bound by them. Precisely the point of this study is to search for some thread, some other voice existing in these readings that might steer us away from the "sacred truths". Thus these readings become more than they first appear. They become the voice of our society, our culture and now the task is to search for their hidden (covered) meaning, to delve into a new realm of experience.

These data were presented in two phases. The first phase is to present the readings in their original form. There was some editing of the text not to alter the original thrust, but to reduce the length of some of the readings.

The second phase of the process is to do an interpretive or strong reading of the text. It is difficult to specify exactly how one arrives at a strong reading of the text but this should not be seen as a weakness but rather as the strength of the study. To do a strong reading takes you beyond the world of method, into a domain where no procedure or technique can suffice. Evans (1989) calls a strong reading;

> "a creative act in which something new is brought into existence. ... whatever truths or insights are revealed by the strong readings are not truths that could be painstakingly arrived at but could only be produced by the effort of the creative (hermeneutic) imagination" (Evans, 1989:51-52).

## RECAPITULATION

In this chapter the attempt was made to reflect on some of the methodological features of this study. Addressing questions of meaning (understanding) cannot be reduced to the status of mere method, rather it is to be understood as an interpretive endeavor in which meanings are uncovered. The intention of doing a strong reading of the text was

justified not as a way of producing technical knowledge but rather as a way of putting oneself right in the middle of the problematic.

The main point of this chapter is the realization that a concern for meaning is not a problem of method but a problem of interpretation. Thus the "validity" or "reliablity" of the interpretations cannot be the outcome of any "technique" or set of procedures. The challenge of this reasearch is to understand the readings presented in the next chapter better than the authors. This is possible because the meaning emerges in the encounter between the reader and the text. The very essence of my approach is interpretative, but this does not mean that any interpretation is as good as another. The clarity of the description and the rigor of the interpretation, must be present.

What makes interpretation so important is that the art of understanding is required not only with respect to texts but also in one's conversations with one's fellow human beings. Whoever wants to understand something must try to get underneath the surface of a phenomenon.

# Chapter IV

## ECO PEDAGOGICAL REFLECTIONS

*Earth Day 1990 - And the word went out to the people: The Earth exists for the human person and not vice versa .... The focus must be on the sacredness of the human person ... not on snails and whales*

Cardinal John O'Connor Roman Catholic Archbishop of New York
St. Patrick's Cathedral, New York

One of the first books I read that helped me solidify many questions concerning the ideas of eco-logical science was Fritjof Capra's book entitled "The Turning Point". This book evoked in me a sense of urgency, a sense that something must occur. The question at that time was: "what must occur"?

Anita Gordon and David Suzuki have used the idea of a "Turning Point" to describe the 1990's as the turning point for human civilization. We are at a crisis point that is forcing us to "re-examine the value system that has governed us for at least the past 2000 years" (Gordon and Suzuki, 1990:1).

Modern man has become accustomed to a certain way-of-life, full of conveniences and does not want to lose or even give up a small portion of them. The problem with our set of beliefs is that our planet is no longer able to support the assumptions that have founded our consumeristic culture. We face a turning point, a point that forces us to address

the ecological disasters that we have created and the value system that guides us. The assumptions we have made about ourselves and our planet are no longer able to be accepted. These "sacred truths" that we have grown up with can no longer be accepted without question. These "sacred truths" are that:

> "... nature is infinite; growth is progress; science and technology will solve our problems; all of nature is at our disposal; we can manage the planet ... . In fact ... to continue to subscribe to these assumptions is to ensure the destruction of civilization as we know it" (Gordon and Suzuki, 1990:1)

The purpose of the present chapter is to offer a series of readings highlighting the positions of the dominant paradigm in educational curriculum, reference works, and general "expert" material. Each reading begins with a short introduction of where that particular reading was found in order that it may be contextualized. There are two phases in the work to be presented as mentioned in the previous chapter. The first step is to present each reading in its raw and relatively untouched form. In the second phase of the research each piece of text is interpreted as a strong activity. A normative interpretation is engaged in such that being neutral towards the text is no longer possible or even desirable.

READING ONE

PESTICIDES NECESSARY BUT DANGEROUS POISONS

The following reading is the cover article of a recent International Development Research Centre (IDRC) magazine. The mandate of this publication is to keep an "international readership informed about the work IDRC supports in developing countries, as well as other development issues of interest." The story recommends the continued use of pesticides in agriculture. This message is quite clear. However, I am concerned with the meta-message of the passage being forgotten. What is the result of the use of pesticide use environmentally?

PESTICIDES NECESSARY BUT DANGEROUS POISONS

> Is this the price to be paid for high performance agriculture, which increasingly relies on fertilizers, herbicides, and fungicides? ...
>
> Agriculture is now almost impossible without chemical fertilizers or pesticides. In the tropics, most of the soil is not very fertile. Fertilizers are a welcome adjunct. But most of the pests that undermine agriculture are also found in the tropics: rodents, insects, nematodes, fungi, weeds, and so on.
>
> ... As a way out of the impasse, modern agricultural strategies must be employed, the soil must be continuously enriched, and a strict program must be established to control insects and other pests that destroy crops.
>
> Pesticides also play an important part in most battles against diseases transmitted by insects. Programs to destroy the vectors of malaria, leishmaniasis, ... with pesticide sprays have been partially successful.

Unfortunately, this approach by itself presents some serious problems. It is expensive and increases Third World dependency on the industrialized countries that supply the chemicals. ...

Although human health appears to be seriously affected, that is not always true for the insects. The impressive recuperative power of insects from generation to generation is too often forgotten. ...

This explains why the campaigns against malaria-carrying mosquitoes ... are doomed to failure. ... Since 1945, more than 15 000 compounds have been synthesized to circumvent insect resistance. ... Nevertheless, insects continue to ravage crops and spread disease. ...

Some developing countries such as India and Egypt, have attempted to reduce their economic dependency on the North by asking multinational chemical producers to set up operations on their soil. In theory, this decision is logical. It allows the countries to produce those pesticides that are indispensable for agricultural production and the maintenance of public health, at affordable prices. In addition, jobs in pesticide plants have become a coveted source of income for workers. ...

To deal with insect resistance and pesticide toxicity to people, producers have turned to new classes of compounds often of plant origin. ... These compounds are less toxic to people. However, several cases of poisoning caused by imprudent use have been reported, particularly in China. ...

Third World researchers must never lose sight of the complexity of the debate. How can an expanding population be fed without harming the health of farm workers? How can the impact of insect-borne disease be reduced without destroying the ecological balance of our environment?

Epidemiological studies have shown that farm workers are the group hardest hit by accidental poisoning. This could be solved in part by education and training programs. ...

> Two other articles deal with attempts to develop and use less harmful pest control techniques. One describes research in India aimed at using a naturally-occurring tiny parasitic organism called "Nosema locustae" to control locusts. ... the objectives are complementary: to sensitize governments and users by clearly describing the scope of the problem; to identify the cases of the poisoning and if possible discover appropriate solutions; and to find less toxic alternatives to the excess use of pesticides (Forget, 1989:4,5).

INTERPRETIVE READING

This text is about the use of pesticides in a context that implies that the non-use of chemical fertilizers and pesticides is somehow wrong. The author puts forward a strong statement that "agriculture is now almost impossible without chemical fertilizers or pesticides." The question of where these assertions are derived from must be kept in mind. Pesticides are a "tool" of agricultural practices in the west. Tools (ie. pesticides) often define a problem. The original purpose of pesticides was to enhance the yield of crops not to be the savior of modern agriculture. Pesticide use has shifted from the attempt to increase crop yield to a necessary feature of modern agriculture. Ursula Franklin (1990) writes:

> "If you have a particular type of kitchen equipment, you begin to slice and dice as you have never done before. Other means of food preparation become *less attractive and you*

> *may eventually forget about them*. If your lab gets an electron microscope, you will find it difficult to persuade students to use optical microscopy (Franklin, 1990:56)."

As with most text, a strong reading requires that we see the story told by this author as some kind of recommendation to the First and Third world that western agricultural science is <u>the</u> way that farming practices ought to take place in the Third world. The author, unconsciously, is recommending the way we in the First world ought to view the Third world. The possibility of death from the use of pesticides is not the issue. The issue is how to educate the Third world in the use of these chemicals. In fact, how to transfer our science of agriculture to others.

The contrast between the benefit of the chemicals and the toxic nature of these chemicals is the crucial issue of the story. The crucial issue under the story, the meta-story, is that the author (in making a case for continued pesticide use) has done so within an unquestioned framework of science. The science of agriculture as it is known today claims that chemical use is correct and that without the use of chemicals of various sorts agricultural production will be seriously reduced. The irony is that the Third world is seen not as a place where people live, as our home is, rather the Third world has been objectified within a

framework of western technology, in this case agricultural science.

This is what a strong reading of the situation would want to make clear. Central to the idea of the use of chemicals is the structure of science. There is much more here than a comment on the continued need for pesticide use, technical or otherwise. There is a reflection of what constitutes the advancement of the relation of Man to the natural world as a reflection of what is seen to be needed, agriculturally, economically, and technically.

READING TWO

BOTANICAL WEALTH OF THE RAIN FOREST

This reading was obtained from a teacher-colleague who was involved in teaching a Grade Eight Social Studies unit focusing on Brazil. A large component of this unit included the study of the environment. The question of the destruction of Brazilian rainforests was topical and therefore was incorporated into the students' study of Brazil. As a result of public awareness the students were asked to gather information by sending letters to groups asking for information concerning the rainforests of the world. The contact groups provided by the instructor included governmental agencies, industry related to the rainforests, and environmental agencies. The following

reading is a portion of what was received from a group called "Rainforest Action Network". The class read and discussed this material using it as material from which presentations were developed. The message of the articles is clear. However, as with the previous article I am concerned about the loss of the meta-message of the reading. What about the wholesale destruction and exploitation of the rainforests? This is the focus I want you to hold during this reading.

BOTANICAL WEALTH OF THE RAIN FOREST

> It is estimated that between 500,000 to 2,000,000 (10 - 20%) species of animals, plants and insects will be extinct by the year 2000, the vast majority in the rain forest. Seven thousand medical compounds prescribed by western medics for their patients are derived from plants. 70% of the 3000 plants identified by the United States National Cancer Institute as having anti - cancer properties are endemic to the rain forests. Of the amount of the forest that will vanish permanently, how many thousands of unknown treasures of medicine are we losing with it? The plethora of ecological resources in tropical forests translates into tangible life saving advances; only a miniscule amount of the available plant and animal species have been examined for their medicinal value, yet thousands of acres of rain forests are irreparably damaged every day. ...
>
> Finally, rain forest plants provide aids for research. "The chemical components of plants that medicine men use in healing rites could conceivably be building blocks for new drugs or even cures for such scourges as cancer or AIDS." Certain plant compounds

> enable scientists to understand how cancer cells grow, while others serve as testing agents for potentially harmful food and drug products. Tropical forests offer hope for safer contraceptives for both women and men. As world population continues to grow, so does the demand for reliable and effective birth control methods. At least 370 of an available 4000 species have been shown to offer anti-fertility possibilities. The rain forest also holds the secret of providing farmers with safer pesticides. ...
>
> What can you do?
>
> There are no easy answers to the social and environmental crises facing the rain forest today. An important step towards saving the rain forest is recognizing the impact of rain forest medicines in our modern pharmacopeia. Tropical forest plants serve as vital resources in the eradication of disease. We are in grave danger of losing the plants and, more importantly, the knowledge needed to access the available resources. We cannot continue to destroy the storehouse of genetic material, the possible medicinal gifts that the rain forest could bestow upon us. The plants that comprise the forest have only begun to be explored for potential cures. The medicinal sources are truly limitless - if the forest is properly managed and maintained. It is our responsibility to participate in the vigorous efforts to protect the rain forest before that habitat, its dwellers and the hopes and possibilities of the future are supplanted permanently (Rain forest Action Network, Reading, Grade Eight Social Studies).

INTERPRETIVE READING

The intent of the story is to give the reader rational, sensible reasons why we need to save the tropical rain forests of Brazil. The story tells us that we have been irresponsible with the <u>management</u> of these forests because

we do not understand the implications of our actions. The solution is to derive a better reason so that we can justify our concern on rational grounds and therefore be able to curb our irresponsibility. The author's key point is that the destruction of these forests are daily destroying a plethora of medicines. For us, however, the question that remains is: Why do we see (ie. understand) forests only in terms of the economic or medical potential they may produce, not simply as a forest? Common-sense tells us that forests are being destroyed at an incredible rate and that we must stop this "progression". However, this "scientific" conclusion seems not to be sufficient to curb the continued destruction of the rainforest. The awareness of the destruction of the forest seems not to be a sufficient reason to "save" the forest, there must be "better", ie. a more progressive reason. But still a "reason" nonetheless. The reason is the possibility we may be losing drugs that are yet to be found in the forest and that may be of benefit to us (ie. the First world) in the future. The rain forest has therefore been objectified as a source of a particular form of medicine, rather than understood as, or related to, as important itself. The forests have now been objectified as an object on call for inspection and use by man.

This particular story unfolds in a direction that is unmistakable: we simply must stop the destruction of the

rain forests. And yet the reasons presented in this passage that we are to accept are that we may be destroying something (medicines) that may be of benefit to us in the future. The solution is completely tangled in the western cultural presumption of science, management and domination. The natural world is seen as incapable of taking care of the health of the rainforest. To aid the forests man creates the science of management. This attempt to help inevitably ends up dominating the forest, is the shaper of the forest such that it fits in terms of "economic reality". In other words to treat the response to the destruction of the forests as simply *the thing one ought to do* cannot be seen as a responsible response to the situation. There is no attempt to ask: "What are we doing this for?" The preferred course of action is based upon "reason", not necessarily "the" reason, but an arbitrary one based upon the objectification of the forest as a pharmacopoeial (object), to serve man.

The recommendation that the story provides is that it cannot be read as just any story, but as an answer to the problems of the destruction of the rainforest. The answer is to be found once again within the realm of scientific reason. What is being recommended to us here is the need to rationalize a solution based upon the forest being seen (ie. understood) as an object. This scientific rationality is

the final accomplishment of the will to dominate. The forest has been framed technologically and scientifically and we cannot understand or conceive of our relation to it any other way.

The story, in brief, seems to be recommending to us that to understand this particular problem is to understand only from the standpoint of scientific reason a univocal vision.

READING THREE

IMPORTATION OF 'POLLUTION' AND MENIAL ACTIVITIES

This reading is a passage from Herman Kahn's book "The Next 200 Years". This book describes America and the world based on facts, assumptions, analysis and conclusions of studies of the "... major current problem areas ... of population growth, economic development, energy, raw materials, food and the environment... ". From the analysis of these areas Kahn evolves an "affirmative strategy" for the future (Kahn et al, 1976: jacket). This reading is one of ten forces described by Kahn, that will aid the economic growth of the developing nations. Each of these ten forces are described as "unique to the developing nations and each taking advantage of the gap between them and the developing nations" (Kahn et al, 1976:34-35). The author puts forward a spirited statement that it is common to sneer at the idea

of the exportation and importation of industrial waste through direct means or through the importation of technology in such a way that it could not be viewed as anything but natural. The question of where this attitude has been developed must be addressed. Kahn puts forth the view of the resource potential of the Earth as a simple economic calculation. The resources of the Earth will be more than sufficient over the next 400 years with a wide margin of safety "to sustain, for an indefinite period of time and at a high" standard of living" (Kahn et al, 1976:26-27). Specifically Kahn summarizes:

> "... 200 years ago almost everywhere human beings were comparatively few, and poor and at the mercy of the forces of nature, and 200 years from now, we expect, almost everywhere they will be numerous, rich and *in control of the forces of nature*" (Kahn et al, 1976:1 emphasis added).

## IMPORTATION OF 'POLLUTION' AND MENIAL ACTIVITIES

> It is common today to sneer at the concept of shifting polluting and annoying activities to the developing world, as if it were unfair or even immoral to do so - a particularly reprehensible exploitation of the Third World. Practical people understand that this is not so. The poor and the untrained have always done the dirtier and less pleasant work, and this is true among countries as well as between them. In fact, one of the main opportunities for the poor and the untrained is to undertake those activities which the affluent and well trained no longer wish to do for themselves

> or can no longer find local people willing to do.
>
> Of course one must be reasonable. We do not expect poor and untrained people to accept risky or unhealthy occupations, and there is no reason why a country should do the same - for example, no country should be willing to import dangerous kinds of heavy-metal pollution, at least not under normal circumstances. On the other hand some erosion of clean air and pure water standards is almost inevitable if there is going to be rapid development. But since many new anti-pollution technologies are now readily available, the sacrifices that may be made here are going to be much less than those already experienced by the developed countries. There is no particular reason why one should look askance at this process or feel in any way uncomfortable about it. In much of the Third World, the greatest pollution is poverty, and it is worth making very great sacrifices indeed to reduce that blight rapidly and effectively (Kahn et al, 1976:43-44).

INTERPRETIVE READING

This story is a recommendation to the reader that Western practices can be rationalized through the thinking that the industrialization of the Third world by First world technology will ultimately be best for the Third world. The meta-message of the passage is that our economic practices are the best methods for the "advancement" of the Third world to the level of the First world. The author is recommending a view that the Third world ought to strive to be like the First world. The issue is not the exploitation

of the Third world as the recipient of First world waste but the waste itself is seen as the inescapable by-product of the means by which the Third world can elevate itself to our (First world) level. The issue is not the known problems that pollution from modern technology brings, rather the twin sciences of economics and management are seen as the salvation of the Third world at their expense. The pollution that the technology brings with it is not seen as a problem since technology itself can or will in the future be able to cope. The real cost of this technology is that developing nations will receive our (First world) waste through the technology we have given in order to "improve their lot. The problems that surround modern technology have not been considered as reason for not proceeding with this type of development. "Of course one must be reasonable ... some erosion of clean air and pure water standards is almost inevitable if there is going to be rapid development." The contrast between, on the one hand, that the environmental damage may be caused by the "shifting of polluting and annoying activities to the developing world", and the economic benefits to be derived from these activities makes a case for proceeding based upon a framework of science that, "... many new anti-pollution technologies are now readily available...". The science of pollution management, as it is known today, is used to make

the claim that what cannot be performed in the First world any longer, is an acceptable risk in the Third world. We now have the technology that will reduce the risk of danger from the activities surrounding "pollution importation", but not with the inherent dangers concerning pollution. The irony is that the Third world is not seen as a place where people must live, but as a projection, a representation, as a place where given our help these people can ascribe to our level of development by the uncritical acceptance of First World technology and scientific cultural notions.

This is what a strong reading of the situation would want to make clear. The central idea is that the development of a region must be married to a particular notion of economics and science. There is much more here than a comment on what Kahn claims to be one of ten forces that will aid growth. In addition there is also a reflection of what is seen to be needed economically and technologically. In short, what constitutes progress.

READING FOUR

WATER CYCLE PURIFICATION; WATER: WHO NEEDS IT?

This reading is taken from a CORE UNIT of the Alberta Grade Six science program. This unit, Water and Land, is an investigation of wind and water as agents of erosion and deposition. Water and Land studies the influences of

natural phenomena and human activity on the characteristics of water quality. Through the study of these influences the student increases his "sensitivity to the need for control and conservation measures" (Elementary Science Curriculum guide, 1984:24).

The Elementary Science study units puts into the hands of the student materials that help the student investigate the "nature of the world around him" (Elementary Science Curriculum guide, 1984:21). The meta-message of this particular reading is bothersome since while the nature of pollution is correctly identified, only solutions of a purely scientific nature are proposed. The meta-message of this story is strong in the sense that man may not need to worry overly much about water pollution since nature and technology will ultimately be able to supply all the clean water we need. This is what this story seems to be recommending to us. However, I am mainly concerned with the meta-message of this story, namely the recommendation of water use. We need to ask ourselves whether these solutions are any longer acceptable?

WATER CYCLE PURIFICATION; WATER: WHO NEEDS IT?

The water we drink has already been used - hundreds of times. Nature's recycling

process cleans up the water after humans use it, and makes it fit to drink again.
The first problem is that humans are polluting water so fast that nature can't clean it up before we want to use it again.
The second problem is that water isn't always where we want it, exactly when we want it.
To help solve these two problems, people need to start saving the water we DO have.. This is called conservation. We are asked to conserve many things already - natural gas, oil, electricity, aluminum cans, paper, wild animals - but water is by far the most important.
What would people do without water? Very little! Human bodies are over 3/4 water. Half of ordinary food is water. Trees need water to grow to give fruit, make paper, pencils, and wood for houses. Cows drink water to give milk. Soft drinks like Pepsi, Coca - cola and Kool - Aid are mostly water. Water is used to make cloth for jeans and shirts. When water freezes, it makes snow for skiing and sledding. When water melts, it makes streams for fishing and watering gardens. After water is cleaned, it makes swimming pools or drinking water. There is almost nothing humans can do without water. ... The only hitch in this natural healing process arises when there is too much pollution for nature to deal with. When this happens, people have to build treatment plants to help clean the water (Student Reading taken from Grade Six Science II Earth, Space, Time Unit C, Water and Land, 1984:III-5).

INTERPRETIVE READING

This reading is a story about the changes that continually take place on our planet through erosion and deposition. The author describes the water cycle as a

natural act, "Nature's recycling process cleans up the water after humans use it, and makes it fit to drink again."

The opening paragraph of the story implies that water is for man's use, "...water isn't always <u>where</u> we want it, exactly <u>when</u> we want it..." There is a conviction here that after man uses water it is not fit for use again until the water is recycled through the natural water cycle or through a water treatment plant. There is a strong recommendation in this story that nature is having difficulty in cleaning water due to pollution, but no reasons are given as to why this might be the case. What a strong reading of the text would want to make clear is that water has been objectified as an object on call for man, to be the servant of man, nothing more. There is no question of the intention of the authors to make clear the story of the water cycle, however the assumptions of the fundamental nature of water have been misplaced. "Trees need water to grow to give fruit, make paper, pencils, and wood for houses." The tree needs water it seems only when in the service of man. There is a sense from this that trees only need water if they produce products for man's use.

A strong reading of this passage requires that we see the understandings that are buried within the text as a kind of recommendation to the reader of how to interpret what the

text is talking about. In a way the authors are saying that nature cleans water for man's use.

> "Soft drinks like Pepsi, Coca - cola and Kool - Aid are mostly water. Water is used to make cloth for jeans and shirts. When water freezes, it makes snow for skiing and sledding. When water melts, it makes streams for fishing and watering gardens" (Student Reading taken from Grade Six Science II Earth, Space, Time Unit C, Water and Land, 1984:III-5).

The key is that water was placed on this planet for man, and for no other reason. Snow seems to have no other use than that of skiing and/or sledding. Furthermore, the natural cycle is only something to study until man is able to clean water more effectively, that is until man can do it better.

> "... The only hitch in this natural healing process arises when there is too much pollution for nature to deal with. When this happens, *people have to build treatment plants* to help clean the water" (Student Reading taken from Grade Six Science II Earth, Space, Time Unit C, Water and Land, 1984:III-5).

First we are led to see the problems with water on our planet. "The first problem is that humans are polluting water so fast that nature can't clean it up before we want to use it again. The second problem is that water isn't always <u>where</u> we want it, exactly <u>when</u> we want it." In both cases the object, water, is somehow incomplete, lacking, either polluted, or misplaced. As a doctor diagnoses a medical problem of the body, so this reading has diagnosed

the problems with water. In a way the authors have disconnected the object, water, from the planet.

What kind of understanding is at work here? Water has been renamed and re-interpreted as the servant of man. It is no longer what we remember as pleasant, or enjoyable or as simply there but as an object to serve us in life as material, at our disposal, disposable. Yet this is what the story seems to be recommending to us, that water is now merely a substance at one's disposal.

READING FIVE

THE EXECUTIVE FUNCTIONS OF TEACHING

This reading is taken from a popular undergraduate textbook entitled "Learning To Teach". This particular textbook focuses on general models, tactics and skills that apply to teaching in all subject areas and at all grade levels. The author has tried to provide the student-teacher with what he believes to be a comprehensive and balanced view of teaching beginning with the "Scientific Basis for the Art of Teaching". This beginning lays open this textbook's three major foundations. These consist of the interactive functions of teaching, the organizational functions of teaching and the executive functions of teaching. The idea of the scientific basis of teaching is put forward in order to guide the beginning teacher's

practices. From this scientific knowledge of teaching principles, the author suggests guidelines for how "best practice" can be achieved. The question to be raised is whether teaching can be objectified as a science (ie. able to be quantified) as the author suggests.

## THE EXECUTIVE FUNCTIONS OF TEACHING

> In many ways the contemporary teacher's roles are similar to those of executives and managers who work in other types of organizations. Executives are expected to provide leadership, to establish procedures for effective motivation, and to coordinate and control the activities of various people working independently to accomplish organizational goals. ... Berliner (1982b) also reminds his readers of the historic link between the concepts of teacher and manager that grew out of the industrialization process in Western Societies. Although this image has been embraced by some educators, it has also been criticized for its tendency to make people think about schools the same way they think about factories; for its overemphasis on the technical and skill sides of teaching; and its excessive attention to control, orderliness, and efficiency at the expense of creativity and spontaneity. Regardless of past misuse of the teacher-as-manager metaphor, there are indeed many parallels between the work they perform. "Learning to Teach" presents these executive skills in a manner that does not violate the artistic side of teaching, that is, teacher creativity and spontaneity (Arends, 1991:10).

INTERPRETIVE READING

The author in this passage immediately sketches what a teacher does as a number of roles in many ways similar to the roles of executives. A teacher is like an executive even though we do not know what an executive is in contrast to a teacher. In fact the author suggests that there may in fact be no difference between teachers and executives. However, it is difficult to imagine that between teachers and executives there is no range or scope of differences. The question must be, what is it teachers do that may be seen as similar to what others do? According to Arends effective motivation, coordination and control are the activities that are similar. Is this all? What kind of "prototype" is suggested by such statements, especially to beginning teachers. Clearly the author does not "see" teachers as teachers. Rather he "sees" a group that includes teachers bounded by a general theory of organization. The teacher is part of the organization of the school, not essentially a teacher but part of a greater organization. The operation of an educational organization is a science-based operation founded on the principles of management science. Teachers and their occupation must be <u>founded</u> in science since the they co-exist within the framework of the institution. The recommendation is that to understand

teaching is akin to understanding any organization. The parts of both organizations are interchangeable.

What else is involved in the author's description of the function(s) of teaching? We are to "think about schools the same way they think about factories... there are indeed many parallels between the work they perform." We could imagine a whole range of possible interpretations of what a teacher is and does and perhaps in some ways what a factory worker does, is akin to what a teacher does. But is this teaching? The author's questions are clearly aimed at talking about the things teachers <u>do</u> (ie. reading, walking, giving lectures, eating lunch) but not about "it", teaching.

But what does it really mean to be a teacher? When we try to define or compare things such as teaching and factory workers we miss much of what "it" is (ie. what makes teaching, teaching). For example, saying a school is an enterprise "like" a factory, tells us little about what teaching "is". Trying to understand teaching "in-terms-of" something else, say factories, is at best folly. In creating definitions or "rules-of" teaching we will not understand teaching (ie. what it is to teach). At best we will know the things teachers "do".

## TOWARDS PRACTICE

This section raises the question of practice. What is practice? Practice is typically thought of as the performance of some act. It is generally linked to the pursuit of some profession such as law or education. The practice of that profession may be seen as the action of doing something, working things out, solving problems of one kind or another. This is what it means to be involved in a practice.

Therefore, what of the practice of eco-logical science? The question may be raised: how do I teach eco-logical science in my classroom? What questions should I, as the teacher, ask and what type of student responses could be seen as appropriate? This raises the question of method, in particular what "method" should I use to best present the ideas of eco-logical science to my students? What "method" do I use to "do" this teaching? How am I to practice eco-logical science within my classroom?

The challenge of these questions is to recognize that eco-logical science is <u>method-less</u>. There are no "steps-to-teaching" eco-logical science. To understand eco-logical science is to understand the deep purpose and essence of what eco-logical science stands for. Clearly as a practice eco-logical science does not exist within the world of the classroom as posters on the walls or as pictures or charts

in some textbook. Rather, eco-logical science if it lives anywhere lives within the teacher. The teacher lives eco-logical science; it becomes part of who the teacher is in such a way that questions of "practice" become ultimately meaningless. Methodological questions of how-to-teach become meaningless questions.

Given this understanding of eco-logical science what of curriculum matters? Teaching within the world of eco-logical science would not require any fundamental change to what already exists as curriculum. What would change is the nature of the relationship between the teacher and the curriculum. Once understanding occurs, the relationship changes and that change in the relation is everything. As the work of this chapter implies, it is not the texts themselves that is critical, but the relationship between the interpreter and the text(s) that is important. If this study has said anything, it has claimed that a "method" cannot be employed to seek the truth. There are no "methods" or steps to the "practice" of eco-logical science. What there is, however, is a deep understanding of children's questions. In this view, education leads to understanding; it has no more "practical" aim. It does not have as its "object" the "production" of politicians, workers, citizens, or businessmen. It is interested in the

growth of human beings through the fostering of a sense of who and what we are.

## RECAPITULATION

Our attention must now turn on the possibility of recapitulating the contents of this chapter. The main task was the attempt to make problematic science's domination of our way of thinking and perceiving significant aspects of our world. This was an interpretive activity undertaken in the hope that by engaging in a series of strong readings the domination science has upon contempory culture would become clear.

While it would be possible to endlessly recapitulate the approach and the methodology used in this study, the "contents" of the strong readings are not amenable to this type of recapitulation. When we try to say what it is we know, or when we try to take in hand the contents of this knowledge we find there is nothing there. There are no contents that could be recapitulated since each time we come in contact with a reading we re-interpret the reading differently. We re-interpret even when trying to read with the same understanding as before except that the passage is presented to us somehow differently. We are not as naive as the first time perhaps. In this study we find ourselves in the presence of a form of truth or knowledge which cannot be

severed from the process or method by which the knowledge is produced. What kind of knowledge is this?

It is beyond the scope of this chapter to deal in detail with this question. However, it is important to note that whatever insights and understandings *come to us in* this chapter they could not be arrived at through impatience, experimentation, manipulation of data and so on and so forth. Such a process is likely to push understanding away from us rather than permiting us to share a common moment with the question. To share a common moment is to expect to wait. In fact one is engaged in waiting most of the time. Not empty waiting as you would wait for a bus on the street, but a full moment of thinking and reflecting as thoughts come to you. Waiting, patience and a certain devotion take the place of method. Our current practices may question the validity of such knowledge, yet to understand this knowledge we find ourselves questioning current research practices, and even what we understand by research itself, in a fundamental way.

# Chapter V

## RETURNING TO THE QUESTION OF INQUIRY

*... we are encouraged rather to let things be what they are and show their manysidedness*

Martin Heidegger

We see the world through the words that we speak and hear, however these words are not necessarily audible. I am not thinking of language as object but as the living word which ultimately is constituted as meaning. When you read this passage you do not read words or hear sounds, you gather meanings. When you read strongly, authentically often what is not said ie. the meta-message of a passage, is more revealing than what is said; the breath between words can be more meaningful than the words themselves. Without reading or listening strongly to the meaning embedded in the language of text, the words can conceal as well as reveal.

This chapter raises the question of questioning. Not a general question or as Gadamer (1982) puts it a false question but a true question. To ask the question that is not yet settled. Why do we ask questions? What purpose do they serve? Generally we think of questions as statements made so that efforts are focused on finding some answer (ie. what is the focus of your question?) We ask questions to interrogate. A question is the interrogative statement of

an object that needs to be investigated or discussed. A question is the basis of a problem. To question is the action of inquiring or asking. Is there more to what a question is? It seems that the act of questioning (inquiry) ought to be more than the simple act of asking. The very essence of a question implies that the asker has a deep sense of wonder that must precede the asking. We do not ask questions for no reason. We ask questions first and foremost because we are curious.

To ask a question is then to set forth on a quest. To leave on a quest is to set out on an adventure such that the end of the quest is as yet unknown (ie. we cannot have [a-priori] an absolute destination in mind). To set out on an adventure is to do so without a pre-established design; so an adventure becomes a chance occurrence; an (ad)venture. To seek adventure is to seek risk, the risk of not knowing if you will be successful with your quest, your quest(ion). To ask a real question leads us in unknown directions, towards adventure where we risk all. To ask a true question is a hazardous enterprise for in asking a true question one must leave the known world behind and venture forth into the unknown.

If, when we question, we seek only certain predictable knowledge then we miss or forget half our world. We forget the ambiguous nature of our world.

> "Phenomenology is the study of essences; and according to it, all problems amount to finding definitions of essences ... [Phenomenology also] puts essences back into existence, and does not expect to arrive at an understanding of man and the world ... It is a transcendental philosophy which places in abeyance the assertions arising out of the natural attitude, the better to understand them; but it is 'already there' before reflection begins ... (Merleau-Ponty, 1962:p.vii)."

One result of doing a strong reading is to gain a view of how each piece of text stands open to us. The questions the text makes problematic identifies what, if anything, bothers us (ie. makes us think). The important question becomes: what do the readings have to do with our approach to science teaching? How does the view we gain in doing a strong reading help us understand the relationship between the text and its meaning?

The first task of the readings is to show the power that "technical rationality" has on "all" of our writings. The task remains as before to challenge science in order "to recall science to itself" (Burch, 1986:p.17). To do this requires a radically different "seeing" of science and therefore the teaching of science. From the work of the previous chapter we can see that sciences' understanding of the world is reflected in how we write and how we interpret our world. To re-interpret our world is the task, accepting

all the variation and the ambiguousness that exists in the world. This is what we want to understand. We no longer want to objectify a problem such that we can make a claim that we now "know the answer". The readings of the last chapter imply something quite fundamental about the nature of the accepted notion of inquiry. The accepted notion of inquiry is intended to tell you that the answer to your question is this or that. Inquiry is a stipulative exercise such that to suggest or point to a possibility is not seen as a solution; rather it is seen as a weakness in that you don't know the answer to the question. These readings are not disembodied instances of our world; rather they are snap shots of our world as seen through language, the language of science.

QUESTIONS: A STRONG READING AND SUBJECT MATTER

In engaging in a strong reading of the passages one gains a view of an alternate way of understanding the meaning each reading contains. Doing a strong reading is not destructive but rather constructive. A strong reading opens each text to us. And yet this openness is only achieved if the reader in experiencing the text allows himself to be placed in the attitude of letting be, rather than imposing his own sedimented, theoretical constructs upon the phenomenon in question. Our theoretical constructs

often cover the phenomenon and in order to re-cover it we must do so by an "allowing process", to get back to the things themselves (the phenomenon). The relationship between the text and its meaning must be understood, yet how does the "aha, I see it!" in the text appear? What is "it" that I "see"?

## TEACHING AND SUBJECT MATTER

Empiricism has emptied phenomena of all mystery by bring them down to substances. We now know what "this" is as it has become objectified such that science can speak about "it" but not speak "it", the "it" that I can see. This question is for science impossible since science assumes the form of the substance is "this" or "that". For teaching this means that all things exist as objects to be discovered by the student and that the object can only exist as "this" or "that". In mathematics then, all concepts must be nothing more than "this" or "that".

In teaching it may mean that I can tell stories or talk endlessly about my subject area, my specialization. Therefore to know my particular subject means that I must know something in this domain of human knowledge. However, to know something does not mean to know just anything about something. To know something about science education does not mean that you or I simply know things about science

education. Often the way we teach is mistaken for what teaching is. What we actually do as teachers is not identical with what teaching is. Most of the time we do not know "it" we know something about it. To truly know something is to know what that something is in the way that it is and speaks to us, not as final and absolute, but as a resting place from which we can continue to know from.

To teach one must have a relationship with one's subject matter. As a math teacher I ask my students to relate to their work, to experience their work mathematically. This does not mean to do so at arm's length, but rather to be involved such that their work has meaning to them and that their work in turn speaks to them, directs them, challenges them. For this to occur the questions that arise out of the difficulty of the work itself must be free to journey as the subject matter sees fit. The notion of "an" answer to a question dissolves into meaninglessness since the question leads us into the unknown and the student is now on a quest with the subject matter.

## KNOWING AND SUBJECT MATTER

In our struggle to know we claim to learn about subjects, rather than the subject letting us know something of it. This "letting us know" changes a subject, changes a question, changes the way we view these things such that the

"letting us know" makes a relationship possible. To simply want to know the answer to a question within a subject allows no relationship to emerge between the learner, the teacher, the subject-matter and on the other hand, the question. In true learning the subject calls upon us in such a way that its otherness becomes a "voice" to be conversed with. In this way our responsiveness to the subject constitutes the whole relationship between ourselves and the subject matter. Within the bounds of such a relation you do not fully know, rather you talk, think, relate and re-relate your talk to the subject, and the subject responds. Not necessarily with the solution(s) but with the relationship between you and the knowledge you are seeking. This is part of what a strong reading exposes: that to know in part what something is and yet to know at the same time that you may never fully know what "it" is as an object statement.

In listening and trying to comprehend a relationship a student may not "see" the relationship. During a lesson the relationship between multiplying and dividing may be discussed. Let us imagine that during the discussion the student was confused and uncertain about this relationship even though he or she understood some of the facts that were presented. The student had been listening and trying to comprehend the material and had even written down all the

examples the instructor provided. But the student could, as yet, not "see it". Later while day dreaming in the sun the student suddenly saw "it". Suddenly the relationship and the connections and interconnections made sense. Suddenly new meaning presented itself. Whereas before the student was uncertain and confused now he could see the meaning of the connection between multiplication and division. The student could now respond pedagogically, "yes I see "it", I see what you mean!"

QUESTIONS: A STRONG READING AND OUR DESIRE FOR MODELS

The desire for a model is related to our understanding of education and what, we assume, is our task as teachers. The question is: what is a model? The concept of a model implies something larger than a particular strategy, method or procedure. The attributes of a model are, (1) a coherent theoretical base and a rationale made explicit by *its creators and developers*; and (2) a point of view and an orientation about what students should learn and how they should learn, and (3) recommendations for bring about different types of learning. A model clearly can be understood therefore *as something whose appearance mimics or imitates reality*.

If we as teachers say we need a model to help us answer questions about teaching then we have set ourselves up to

teach our children that they too require models. In thinking that a model is the way to understand a particular question or issue we run the risk of layering our understanding of the question according to a pre-existing set of assumptions given by the model. I will venture to suggest that models do not help us see, do not help us have a relationship with the question, ie. with what it is we are seeking. Rather models exist in a world of theoretical abstraction not the reality of lived-experience. For example, we know what it is like to have a certain experience, but if asked to describe that feeling we very quickly know we do not know (or at least cannot put it into words). The understanding of that experience fades as quickly as it appeared yet when asked the question, what model exists that will help us explain that experience, we confidently select one. As educators we tend to rely on a reconstructed logic in our professional endeavors such that we read theory into everything. We layer our understanding according to the dictates of the model and, in essence, make a best fit. We try to bring life to the model from the question rather then try to understand the question through experience, from the life-world.

Doing a strong reading of the data of the previous chapter makes it possible to see <u>the phenomenon itself</u> rather than relying on the re-constructed logic of the

model. The experience of a strong reading always appears as a new strengthening of meaning not as something that can be promoted or imagined through recall. One thing is certain: a strong reading is not the outcome of a method or a procedure that can be quantified; it can only be experienced. A new strengthening of meaning can only occur within a context of meanings that already exist in the student. The relation of multiplication and division to become understandable has to be understood in terms of the existing matrix of pre-understandings that the student had assembled to this point.

Consider the notion of progress in the naive sense, namely as movement from one place to another place. We see the notion of progress manifested as the better pesticide or the better teacher (more effective, more efficient, etcetera). Progress is seen to be a linear path of change such that what is new and different, is better than what was. Implicit in this notion of progress is a disregard for history (since one can't return to what was since that, of course, would not be seen as progressive). In this view the model is seen to be the vehicle of progress and thinking that aspires to be progressive requires a model to *take us there*. And yet

> "A reconstructed question can never stand within its original horizon: for the historical horizon that is outlined in the

> reconstruction is not a truly comprehensive one (Gadamer 1982p. 337).

If, as educators, we consider the model as having value, then we must in our everyday lives relate this to our students. In this relation we teach the need for models as the means of providing a satisfactory answer to questions. The purpose of posing questions to our colleagues or to our students is to engage them in thought and reflection. To truly think and reflect we need to abandon the desire for rules. By its very nature the model is a set of rules that leads us along a prescribed path to a prescribed solution. In asking our students to gather their thoughts and fit them to a model, are we seeking creative solutions to our questions? Hardly; this is a contradiction in our thinking. How, on one hand, can we ask our children to be creative, to think, when in the very act of teaching we make the claim that we need to rely on a model to do our thinking for us? The very nature of a model is that it offers solutions to any question put to it even if the question is unanswerable. Therefore the use of a model predisposes the user to imagine that there is an answer. To be creative (to truly be in search of understanding) you cannot know that there is an answer <u>or even that an answer exists</u>!

Doing a strong reading is to experience text and interpret it through the nest of pre-existing understandings

that each of us have. The student in saying I see "it", I see what you mean, has extended his world of meaning, and in so doing the unknown has now become the known. The non-understandable has become the understandable that in the future will provide the context for new meanings of the text, of division and multiplication.

Asking our children to fit their thinking to the presuppostions of models is in essence asking children to accept someone else's perception of reality. We ask our students to think, yet the reliance upon a model suggests that it thinks. Yet models do not and cannot think.

## RECAPITULATION

In this chapter the attempt was made to work out certain of the threads of inquiry that flow from the strong readings of the previous chapter. Three basic ideas were presented. The first idea concerned the nature of the question. The question can be seen as the link between text and its meaning. Questions help us gain a view of how text stands open to us. As noted in the previous chapter, the understanding of the question cannot be forced from the data (the readings) but must be waited for patiently. The understanding of the relationship between the text and its meaning is firmly rooted in the method of the strong reading.

The second idea presented was the relationship between a strong reading and subject matter. Once again the previous chapter established a new way to look at how research might be undertaken. This understanding takes place when the reader opens himself to the attitude of letting be rather than the "normal" attitude of forcing prior constructs upon the phenomenon in question. This idea of "letting us know" changes the subject, changes the question, changes the way we view these things such that a relationship is possible between the reader and the text. This relationship is what the readings of the previous chapter offered us which constitute a form of knowledge that cannot be severed from the process or method by which the knowledge is produced. By the same token our relationship as teachers to our subject matter also cannot be severed from this process since it is what we give back to our students as understanding. Once again the student must be patient, for the meaning must come to him and not be forced upon him.

The third and final section consisted of a discussion of the desire in education to use models. Models can be seen as the <u>science of questioning</u> in that the model seeks to answer questions based upon itself. The model carries with it a set of prior understandings that endows the model with the power to answer any relevant question posed to it. The

truth is that the student, or the teacher seems not to reflect upon the question, but "inputs" the question into the model such that the model answers the question. Whatever insights and understandings come to be for us, this "coming-to-be" cannot be arrived at forcefully through the process of scientific experimentation, methodological manipulation of the data or the layering of a model. However, if teachers feel that they require models to present the subject-matter to their students then we are asking our children to accept someone else's perception of reality.

# Chapter VI

# CONCLUSION

*We never come to thoughts. They come to us.*

Martin Heidegger

What does all this mean? What rings wrong with this discussion and what rings right? These are the questions I began this study with to try to make problemetic the 'thing' I tripped over. The 'thing' has been identified as science, as the culture of science or perhaps the spirit of science. The approach used has been broadly derived from the thinkings of phenomenology.

What are we to make of all this? This question must now come from the reader; do I understand? In this final chapter the discussion will ask of the reader; Have I changed such that things are clearer to me than they were before? There will be no definitive answers, no flawlessness, in the scientific sense; perhaps there will be a greater number of questions than we started with.

The point of this chapter is to close the study and to recapitulate some of the main arguments. There are many difficulties which remain to be understood.

To be mindful in education is a thread that was introduced at the beginning of this study and is an important undercurrent. By contrast to be mindless is to

accept that there are simple solutions, ie. clear, unambiguous answers to problems. Teaching science is to consider that the topic science, and the method of the topic is able to yield clear and unambiguous answers to problems; however, to do so is mindless. Such a view further assumes that problems outside of the philosophy of science (ie. problems of life, what investment to make, what book to chose from the library) can be answered in a clear and unambiguous way if they can be in fact be answered within science. The best defense to oppose the dangers of mindlessness is to attempt to experience things as they are and then to be critical of our own understanding. To do this is not to think that there are no answers, but as you investigate and re-investigate questions, your understanding of the phenomena will grow. For example, if you ask a child, investigating the properties of water, why is water able to heap up in a test tube when you fill it absolutly full the child may respond that the water is able to do this because water is sticky, ie. it can stick to itself and heap up. The beauty of this answer is that this understanding may be sufficient for the teacher at this moment in time but the question and the understanding (solution) remain and may be re-investigated, (re-understood) again with perhaps a different knowing (ie. scientific). (I would like to say with a more sophisticated knowing of the phenomena of water)

This experience tends to place you on the verge of a better understanding, but never a complete understanding since you will always be disatisfied with your last solution. In this case, the sticky property of water. To some this may seem maddening that there are no absolute solutions to many of our questions. That questions are not static, they are full (even if unintendedly so) of confounding (ambiguity) rather than universally clear paradigms.

Still there are many who firmly believe that the only route to understanding our world is through science. In order to be able to explain to others what a thing is (ie. teaching) science and its method of inquiry is assumed to be the only "true" method at our (ie. the world's) disposal. The following passage from a well known book for teachers in undergraduate teacher preparation programs is illustrative of such a view.

> "It is important that those learning to teach understand what is meant by the *scientific basis of teaching* and also to understand the limits of the research that informs the current knowledge base on teaching. Whereas the scientific bases for teaching can guide practice, it cannot provide recipes and formulas guaranteed to work in every instance. The claim that there is a scientific basis for many of the things teachers do is made with some modesty, knowing that many of the practices of effective teaching have grown out of the experiences of teachers themselves, not research. Also, the knowledge base for teaching is still young and not yet complete. Nonetheless, in contrast to the fragmentary

> and inconsistent knowledge base of two or three decades ago, the situation today is vastly improved. (Arends, 1991: 7)"

There is a difficulty in proposing phenomenological methods to educators since a major goal in phenomenological inquiry is to understand the essence of an occurrence and not make claims for knowing the cause. Phenomenological inquiry focuses on meanings and intentions. The authorities charged with making policy decisions for our schools want practical advice. There is an obligation to be scientific even if in being so yields mindless data. This feeling arises from value judgements of long standing based upon a very strong faith in the scientific method. This faith is difficult to shake except within the analogy of the progress of natural science.

In place of our passion with method and methodology we need to persistently ask the meta-questions. For instance, what place does science have in our world? What place does science education have in our world? Why do we educate? How should we understand the purposes of inquiry? What does it really mean to teach? And so on.

These questions come from a level of my understanding of what it is I do each day in my classroom. The motivation for these questions arises from the mundane, rather practical questions I face each day. Perhaps Gadamer is

right about what we should all be trying to do when he writes: "The only scientific thing is to recognize what is, instead of starting from what ought to be, or what could be. (Gadamer,1975:466)" What Gadamer means by this is that one cannot begin to understand from a method. There is no doubt that understanding is not free of all prejudices, however it has emerged throughout this thesis that the certainty conceded to the scientific method is no longer if it ever was sufficient to guarantee truth. This thesis has tried to go beyond the limitation of method, but not that of science, in that what method does not achieve can be achieved by a discipline of questioning.

# REFLECTIONS

*Can there still be such a thing as philosophy in any form other than that of theory of science?*

Hans-Georg Gadamer

These reflections are my conclusions to both the writing of this thesis and the type of thinking this particular work brought out of me. A large portion of this work was devoted to a concern for meaning. Important in this statement is that understanding meaning is not an exact science rather it is a recognition that to master a moment of understanding is a fleeting goal, rarely if ever captured fully.

It is very early in the morning and I am finally getting the last section of this study completed. It is interesting that for most of this day I have struggled with this summing up. An important feature of this type of work is that when you are ready to sit and write, nothing happens. You cannot decide, with your morning cup of coffee that you will complete a section or finish that reading. Rather when you are feeling frustrated and tired and ready to "give up" the thoughts come to you.

This idea that thoughts come to us is also an important feature of this study. As the previous chapters have tried

show, teaching is mainly telling; this telling becomes an imposition (an imposing) of our thoughts upon our students. This forecloses on the possibility of true thinking and like trying to sit and complete this work it cannot be forced. Yet science is a method of forcing, therefore we tend never to fully understand the phenomenon we are questioning. As I described earlier, to respond pedagogically to questions requires time. We all require time before we could ever hope to say," Yes I see "it", I see what you mean!"

This work has tried to suggest that to "see" education and not just science education, has been an exercise away from constructing a parallel universe using already existing or pre-existing thinking. Rather I have tried to show that in fact the idea of construction is somehow amiss. To build (construct) understanding from a body of knowledge at its first instance diverts the mind from thinking and understanding. To begin with the notion of what can be acceptable puts thinking aside in favour of accepting what is already present. To construct is to shape with a prior knowing of what it is you, as the shaper want. As an architect plans the construction from beginning to end prior to the laying of the foundation, this is akin to what we ask children to do in schools except that they are not responsible for the thinking as it has already been done for them through science. To-work-things-out requires that you

understand the thing without preconception, or as purely as is possible. This forces an "unknowing" to occur and an ambiguity arises that the researcher ought to embrace such that a vision is possible, however fleeting. This is what it means to try to know something. Engaging in work of this kind forces you to look, forces you to see not with an ever finer eye but with an ever-expanding seeing. What this work has tried to suggest is that our predisposition for science has captured our imagination of what is possible before we begin to think. Thus science shapes, organizes, dominates our seeing from the beginning.

Finally, I have found that each time I have worked on this study I seem never able to find an end; an answer. Part of the understanding that arises from doing work of this kind is the realization that a definite destination is not possible nor even necessarily desirable. Such a realization flies in the face of all forms of scientific endeavour.

## Final Musings

As a concluding contribution to this study I wish to put forward some thoughts that have arisen from the life of this work. It is important that these musings are thoughts that have been turned over in my mind but as yet are inconclusive. These musings are a product a of state of deep thought, however they remain in a dreamy state of abstraction.

.the ambiguous nature of our world is that part of the world we are confused about

.to pose a question as opposed to im-posing a question

.are there answers to "questions" or are there merely better questions?

.ethics are not "reasonable" ... ethics transcend reason ... the "reasonableness" of ethics and ethical action is not attributable to reason alone.

.to know that to-not-know is knowing itself

.the moment education becomes economic/functional it ceases to be truly educative.

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