



In Context

Number 16 Fall 2006

The Newsletter of The Nature Institute

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Dear Readers,

In this issue of *In Context* you can experience different voices. You can hear Judith Madey, a cow herdsman, describing essential features of the cow and the cow herd. You can participate in philosopher Ronald Brady's struggles as a young man to be taken seriously in the academy as he pursued his interest in the immediate sensory presentation of chemical substances and their transformations. We also introduce you to the work of physicist, Martin Wagenschein, whose short essay on "Light and Objects" shows you a man committed to leading his students into a real meeting with the phenomenal world. He practices what Goethe called "delicate empiricism." And finally, you can read the more familiar voice of one of us (CH) trying to articulate his strivings to get beyond schematic conceptions so that we can see the world with fresh eyes.

The more we work with the Goethean phenomenological method, the more we realize that there is no *one way* to approach the world. Each individual has gifts and strengths that allow him or her to reveal different aspects of the world. What connects the voices you find in this issue of *In Context*, as different as they may be from one another, is the effort to reconnect us with sense experience—to get beyond habits of thought that place models, theories, and explanations between us and the world.

Inasmuch as any of us succeeds in this undertaking, the world begins to speak. And it does not speak in just one way; it speaks in manifold voices: just as the complex cow reveals the qualities of a unique way of being through its movement, form, and herd behavior, so also the movement of "simple" dust drifting through a sunbeam tells its own tale about substance and light.

We hear and respond to this speaking of nature all the time. But our scientific training may have taught us to muffle our hearing and ignore our responses, since these are, among other things, *qualitative* and *aesthetic*. Scientists have too long imagined that their essential activity lies in an entirely different compartment from that of the aesthetically trained artist. Healing the rift between science and art is a central aim of Goethean science.

As we do heal this rift, we will find that different accounts of the world's phenomena can reveal different aspects of an integral whole, just as different painters sketching the same scene in distinct ways can enlarge our understanding of what we are looking at. We hope to continue making available to you just such diverse, but revelatory, views of the world we live in.

Craig Holdrege



Steve Talbott



The Nature Institute

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In Context is published twice yearly.
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Single copies of *In Context* are available free while the supply lasts. The Nature Institute's online *NetFuture* newsletter is available at: <http://netfuture.org>

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Light and Objects

Martin Wagenschein

An Entryway to Optics

This short essay is about nothing other than physics, or, if you will, an entryway to physics. Such an entry is, however, important because it isn't "just an entryway." As a preliminary stage to physics it is as important as the root is to the tree. We usually tend to forget this stage in our teaching. We must pass through this entryway and experience it both silently and as a preliminary form of thinking. Only then will we be able to understand the pressed and dried forms that comprise the herbarium of a textbook. (Where one finds phrases such as "Light is produced by rays emanating from bodies. We distinguish between light sources and dark bodies, which only become visible..." and so forth.) Passing through the entryway allows us to derive these abstracted formulations in a way that illuminates the experiential elements they contain.

It is very easy to make space for this step in teaching. You prepare the situation: a dark room, an illuminating projector, and dust. The group of children will eagerly throng around this miracle—and then do not speak, let the children speak. They will experience something like what is described in the section below. Afterwards, their experiences can easily be brought into a certain order and—with the teacher as catalyzer—crystallized. When the children then proceed to write down what they have experienced, they will have what they need. No matter how exact his scientific knowledge, a teacher who aspires to bring physics to children must make every effort to remain capable (or become capable again) of stepping back into this entryway.



Sunbeams

When he awoke, the sun shone on his bed. He shook out the blanket, leaned back, and looked into the world of little sunny specks of dust he had whirled up. He had to think of Lichtenberg's words: "What glitters there so beautifully in the sun is in fact nothing but specks of dirt." Their shining dance against the background of the dark cupboard reminded him of the movements of shoals of excited fish. Little by little they quieted down as they gradually descended, more in concert now. He was amazed how slowly. Many of them flickered in settling down, alternatively shining bright and extinguishing. He also remembered how leaves often turn as they fall, showing a shiny flat side one moment, an inconspicuous

edge the next.

These dust particles thus revealed their form as little flakes, without showing their exact outline. By and by he noticed less the individual little stars themselves, and all the more the cloud they formed as a whole, even though he could not distinguish its boundaries. Once again he beat the blanket and chased the swirling dust particles out of the brightness into the darkness where they disappeared. From other places new particles streamed back into the choice zone, where grey dust turned into silver stars. The whole room had to be full of these floating particles, but they could only shine in the beam of light, which stood stiff in the room, indifferent somehow while they played through it. They were not exactly free, but followed their prescribed paths gracefully in two patterns: the particles streamed fan-like or swirled within the ever newly created current, but

MARTIN WAGENSCHHEIN

Martin Wagenschein (1896-1988) was a physicist and educator. He was a secondary school teacher for over thirty years and later became a professor of education at the University of Tübingen for 22 years. He is well-known in German-speaking education circles for his impassioned and clear call to transform science and math teaching. His goal was to reconnect science teaching with both the developing child and nature. He saw the detrimental effects of theory-based instruction and rote learning that inform so much of science education today. He developed an experience-based approach to science education. For him science classes should be first and foremost an exploration of concrete phenomena — students thereby learn science as a process of inquiry rather than as a body of set facts and theories.

Wagenschein is a “must-read” for anyone who teaches science, since he shows how one can lead students to their own insights in a living process of discovery. Moreover, Wagenschein’s essays contain some of the most lucid justifications of phenomena-based science that exist, ideal for parents and others who want to understand the reasons behind this “different” approach to teaching science.

Unfortunately, Wagenschein is virtually unknown in the English-speaking world. Only a couple of his essays have been translated and they are not readily available. Having discovered Wagenschein as a kindred spirit, we want to make his work more widely accessible. To this end, we have begun a project to translate and make available selections from Wagenschein’s work. Over the next two years we will publish selected essays in *In Context* and create a “Wagenschein” page on our website. Once the essays have been translated, we plan to publish the first English-language book of his work.

The little gem printed here, “Light and Objects,” serves as a first introduction to Martin Wagenschein in *In Context*. It may seem simple, but it harbors years of concern about human faithfulness (and lack thereof) to the phenomenal world — to how things actually appear to us. Wagenschein always selected his words very carefully, and his choice of words and phrasing is highly original and pictorial. We have done our best to capture some of this spirit in the translation.

— CRAIG HOLDREGE

then they followed the monotonous and common necessity of falling. But the light beam stood unmoved.

All this lasted only as long as the sun was shining. A cloud intervened, and everything was extinguished. The stiff beam and the swirling stars, they both had to disappear, because they were not two separate things. He saw that now. Without the light beam you couldn’t see the dust specks, and without the little stars there was no light beam. So that is how the light is, he said to himself. By itself you cannot see it, only through the objects. And the objects themselves are invisible unless you see them in light.

ADDENDUM: WHAT IS A PHENOMENON?

A university student wrote the following description about Wagenschein’s approach:

As far as I have been able to understand it, a phenomenon comprises both what we see and observe and what subsequently causes astonishment, reflection and thought. So

something outer (an observation) and inner (a thought) come together and are then so to speak *one* thing, *one* phenomenon. For Wagenschein both things (the inner and the outer) belong together and are interdependent. The knowledge one gains in thinking about a phenomenon is part of the phenomenon. It all belongs together. The example of the light beams, which one suddenly gets to see while thousands of little specks of dust fly through the air, making the light scintillate, I found very impressive and I immediately understood why this fascinating interplay is a phenomenon in the way Wagenschein understood it.

Wagenschein’s original German essay is entitled “Das Licht und die Dinge” and was first published in 1952. The essay and the addendum were printed in Einwurzelung und Verdichtung by Peter Buck (Dürnau, Germany: Kooperative Dürnau, 1997, pp. 43–46), which was used for our translation. This translation is by Jan Kees Saltet and Craig Holdrege, and has been approved by Wagenschein’s literary heirs.

Direct Experience

Ronald Brady

Following is an excerpt from the opening chapter of Being on Earth: Practice In Tending the Appearances, by Georg Maier, Ronald Brady, and Stephen Edelglass. This chapter was written by Brady. For more information about the book and the authors, see the note in “News from the Institute.”

The term “experience” seems to be necessary for any modern English speaker — we continually find that there can be no substitute for the notion. After all, “experience” contains our only evidence of the world, or rather, our only evidence that anything really is, which makes it fundamental to our sense of reality. The term itself derives from a Latin original meaning “test” or “proof.” From the Latin past participle we get the term “expert,” and every entry under “experience” in the Oxford English Dictionary implies the same positive handle on knowing. And in English, an idea, no matter how abstract, must be “sensible” if it is to be considered at all; the underlying reference to experience is linguistically applied to distinguish between “sense” and “nonsense.”

This is why it seems so odd, and so disturbing, that today “experience” often bears exactly the opposite connotation. “Of course, I can only speak from my own experience, but ...” or “Our experience of the matter differs,” which reduces the meaning of the term to something as relativized as “point of view.” Even if the dictionary has not yet caught up with this usage, the average speaker finds it totally familiar. But the odd dissonance this reversal of meaning can create is another matter. Empirical science, for example, should be based upon experience, if we follow the etymology of “empirical” (from the Greek for “experienced”). I suppose most scientists would still claim that it is. But when the uninitiated attempt to come to grips with the actual practice of a “hard” science, they find that the authoritative language has moved from the positive knowing of the first meaning to the subjectivity of the second. And I speak from experience.

Memories of a Wrong-minded Student

When I began college as a chemistry major, my enthusiasm for science was somewhat dampened by meeting a professor of chemistry who pointed out the difference between my own goals and those he, as an

experienced professional, would call mature. My passion, he noted, was entirely focused on direct experience. My sense of chemical change was invested in sensible qualities: in smells, colors, the effervescence of liquids, the appearance of precipitates, the light and violence of flame, and so on. But, he countered, this was probably closer to medieval alchemy than to chemistry. Chemistry is really a matter of molecular and atomic events of which we can have only a theoretical grasp. By contrast, the sensible experience on which my excitement centered was secondary — it was not the external reality but merely the effect of that reality on the human senses.

I was reminded of this professor when I later spoke to a morphologist at Berkeley about my interest in Goethe’s attempt to approach science by keeping to direct experience. The morphologist responded: “You are interested in this approach because you are a nature appreciator, while I am a productive scientist.” I left his office feeling very deflated. Again a representative of science had put his finger on my immaturity.

I hope the reader can feel some sympathy for my situation. One of the difficulties with scientific accounts of the world is their apparent insistence on an “objective” reality that cannot be directly experienced, with the resulting demotion of experience — what our senses make out of the world — to a mere show that differs substantially from “what is really there.” This is something we all know and do not think about very much. When I entered college as a chemistry major this line of reasoning did not distress me greatly, despite the professor’s warning. I had no serious difficulties in basic chemistry and positively loved “qualitative chemistry” — a course given completely to the analysis of unknown compounds, in which sensible qualities like the colors of precipitates were important for the detection of elements.

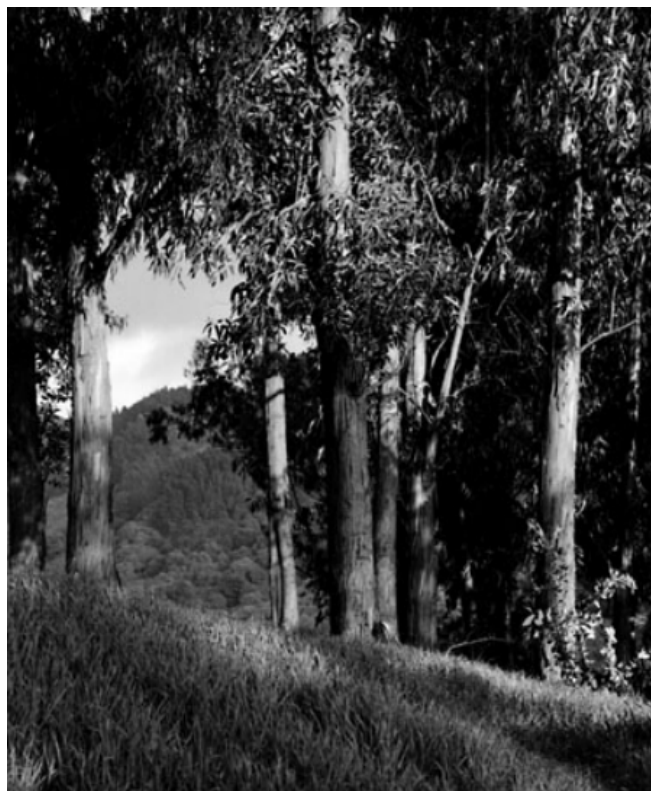
Arriving at “quantitative chemistry,” however, I entered a realm where everything was done mathematically and the mathematics themselves were grounded in an imperceptible molecular world that we could access only by theoretical models. (Years later I discovered that one could teach the course by deriving the mathematics directly from the experienced phenomena, but this is almost never done, and no one showed me the connection at the time.) I now found that the chemistry professor with whom I had my college interview understood my problem better than I did. My first

reaction was to feel the world of chemistry, which had previously contained some of the most beautiful and mysterious experiences of the natural world, now becoming gray, dry, and lifeless. My second reaction was to leave chemistry.

By the time I arrived at Berkeley I was a graduate student in literature. The morphologist had it right — I was an appreciator, and even, as the chemist had feared, a romantic. After all, I now read Wordsworth, Coleridge, Keats, Shelley, Schiller, and Goethe and took them seriously. I suppose I knew that these writers often appealed to a criterion of significance that was both rooted in direct experience and “merely aesthetic,” by which most scientists would understand “merely pleasing.” But unlike my original mentors I still didn’t understand how this sort of corruption disqualified me for science. When I came across Goethe’s scientific works, I became fascinated with his insistence that one need not depart from direct, sensible experience in order to do science. But when the morphologist pointed out that this interest made me a “nature appreciator,” the words seemed to invoke an equivalent of original sin. For a moment my “appreciation” appeared as an entirely subjective act — an assignment of value based on my own pleasure that had no meaning for scientific truth.

It was not long after the conversation with the morphologist — I was still crossing the campus — when I realized that something was wrong somewhere. What had happened to the first meaning of “experience”? I was standing at the edge of the eucalyptus grove. The massive trees towered far above me; their leaf and nut litter covered the floor of the grove. The morning sun was growing warm and the air was pungent with eucalyptus. I could hear birds and a buzzing sound from some unseen insect tribe. At that moment sensible reality seemed very impressive. Was this just my indulgence in appreciation? If I called these things “tangible” and “concrete,” was my criterion merely aesthetic?

How common, I wonder, is this dilemma? In retrospect I wonder how many people come to some form of this question, perhaps more than once, but eventually drop the whole business. Surely that was the advice implied by my counselors. From the judgment that an interest in the sensible qualities of chemistry showed immaturity to the conclusion that a science based on immediate perception was merely “nature appreciation,” my tutors presented a unified front. A modern education seems to produce a tolerance for the dissonance between the two meanings of “experience,” and, most importantly, a willingness to switch to the subjective meaning whenever our experience, if taken



too seriously, might bring us into conflict with accepted theory.

I have become more acutely aware of these things in the years since that Berkeley morning, for although I did not fully realize it at the time, at that very moment I switched from defense to offense. I could not escape the sense that the botany professor’s remarks implied a serious error. Of course, we cannot claim importance for a viewpoint merely because we happen to like it — that is, “appreciate” it — but this sort of criticism simply cannot apply to the importance of direct perception. The immediate evidence of the senses is not a “point of view,” and the first meaning of “experience” — the test of reality — is still valid. Even the scientist cannot afford to lose the ground of experience. I seemed to see it clearly. A mistake had been made.

I resisted the temptation to return to the Botany Department looking for a fight. I saw that the relation between the two meanings of “experience” had not been sorted out correctly, but I was not yet ready to defend my insight. For one thing, I did not understand how or where science, ostensibly based on experience, had demoted experience to a subjective status. Besides, how could a graduate student in literature presume to detect a flaw in so authoritative an institution as science? Big game is hunted with big artillery. My training, it seemed, had left me unarmed.

Over the intervening years, however, I could not let the matter drop, although I began to suspect that current

training left everyone unarmed. I proposed a dissertation on the crossover between scientific observation and aesthetic experience in Goethe's science. Naturally, the Literature Department wouldn't hear of it. Aesthetic experience, they repeated knowingly, is important to literature but not to science. With a certain sense of déjà vu, I left Literature. The people in History of Ideas were more reassuring. They were confident that Goethe's connection between aesthetics and science would make a good dissertation, *provided*, and they stressed the necessity of this, I would keep to the task of tracing influence. Whether Goethe was right or wrong in this matter could not be part of a historical discussion. When I balked, they sent me to Philosophy. The Philosophy Department said they were glad to get me. For how long? I wondered.

Being Serious

This book came to be written when two physicists and a philosopher compared notes. We all shared a distrust of the way direct experience was demoted in the sciences, but more importantly, we thought there was room to do otherwise and do better. Of course, this position was not easy to sell. After all, the development of mathematical physics was made possible by discovering a world that could be the object of *numerical measurement* — in Galileo's abstraction, a world inhabited only by *bodies* divested of all but "primary qualities" (shape, velocity, size, mass, and number). Galileo performed the feat of abstraction, but physics has pursued it since, and, like Galileo, has generally assumed that the resulting picture is not merely a way of looking at the world (a way that allows mathematical treatment), but *the* way of looking — the only true approach to the reality of the world that human cognition can make.

The enormous powers secured by this mode of investigation have produced such an overwhelming impression of success that its authority is beyond question. In one sense, the *truth* of the method is obvious. And yet the image of reality that the sciences have developed leaves out a good amount of the experientially known as uninformative — that is, *less than real*. This conflict has bothered artists and philosophers more than scientists, but it lies at the heart of our present culture. I doubt that anyone who has had any scientific education can escape moments when this dissonance is painfully felt. It is such a normal part of life, in fact, that it has become a background condition for all we do and is hardly noticed until we come to one of those disappointing moments when, perhaps, an aesthetic valuation falls prey to scientific representation.

For all our familiarity with this conflict and our recognition of the authority of science, the three of us did not see the divorce of the scientific and the experiential as a demand of truth. Truth was indeed secured in the sciences, in the verifiable measures of physics and other sciences, but this accomplishment did not, to our minds, mean that the scientific world picture was identical with reality. The truth of a measure is not able to specify its meaning. Only a larger context can do that. Let me explain.

The opposition often felt between the view of much of science and the claims of immediate experience began with the Galilean split between the primary qualities and "secondary qualities" (direct sensations such as colors, sounds, tastes, and smells). The primary qualities are those that, in the Galilean argument, *cannot be divorced from the concept of a body*. The secondary qualities can be divorced, however, and Galileo, reasoning that they were not necessary to bodies, saw no other source for them but the human senses, concluding that "they reside only in consciousness" (Galileo 1957, p. 274). Descartes and Locke were in substantial agreement with this judgment, although they argued that a particular sensation — let us say a certain color — can only appear on a surface if the surface possesses the power of producing that color in the human sense organ, thus linking the color to the observed body. Yet the color itself still resided only in consciousness, for it remained the *effect* of powers possessed by the observed body and/or the sensing mechanism, and the effect need not resemble its cause.

And now a problem comes into view. It is impossible for a world possessing only primary qualities to appear sensibly, since the senses speak in terms of secondary qualities. The primary qualities are discovered through the senses as *relations* between secondary qualities, and must be abstracted from appearances by a mental act. (Shape, for instance, is seen only through variations in color and/or brightness.) Thus we know the world of physics only mediately, as it is deduced from the world of appearances, but the world of appearances is known more immediately, as it appears to experience. Indeed, the primary qualities are part of this experiential picture, but when they have been abstracted from it a great deal of the apparent world has been left behind, existing, it would seem, only as a mental picture in an individual consciousness. This is the *demotion* of direct experience spoken of above.

The effort to distinguish elements of experience in this manner, picking out and relating only those that belong to Galileo's concept of bodies, must be recognized as a great feat of abstraction — one that represents, historically, an advance in human thinking. (*Continued on p. 17*)

In Print . . .

The Nature Institute's staff has continued to enjoy many opportunities to communicate with a larger public through the print media. Here is some of what has been happening:

** Craig and Steve's article, "The Question Science Won't Ask," appeared in the July/August, 2006 *Orion* magazine. The article, which deals primarily with genetic engineering, points out that there can be no fruitful resolution of current debates until the scientist who faces a living organism is willing to ask, "Who, or what, is there?" If, for example, an animal presents us with a unified and coherent nature, a distinctive way of being – if, as Craig writes of the sloth, "every detail speaks 'sloth'" – then who is doing the speaking?

One of our main points is this (quoting from the article):

We can and do, as human beings, choose to modify plants and animals for human purposes. If this interaction is to be at all responsible, we cannot do this solely according to our own sense of utility. At least to some degree, we must get to know the organism we are dealing with on its own terms — that is, by attending to how it expresses its unique qualities through its form, life, and behavior. Only then can we adapt our intentions to its propensities.

All of which led to the following thoughts:

We do not need to choose between arbitrary manipulation on the one hand and the pretense that we can live without affecting the destiny of our fellow creatures on the other. No living organism can exist in perfect isolation. Between the detachment of cold manipulation and that of disconnection lies another option: responsible engagement. That is, we can enter into mutually respectful conversation with the other inhabitants of the Earth. Just as each of us unavoidably influences the people around us and is shaped by them, so it is with all creatures on the planet.

The idea that nature presents us with partners in conversation meets with strong resistance in many corners of society — not just scientific laboratories. Our intensifying history of scientifically-supported manipulation of nature, from wholesale habitat destruction to factory farms to the arbitrary shuffling of genes between species, is proof enough. How alien our fellow creatures now are to us is evident when, for instance, we breed poultry for outlandish aesthetic effects intended merely to tickle our

fancies, or feed animal parts to herbivores to obtain the cheapest weight gain possible. In this last case, our surprise at finding we are driving some cows "mad" is a startling measure of our unwillingness to see the organism in front of us—to see its most obvious and characteristic qualities, its distinctive way of being, its given nature that requires our respect. It is hardly daring or unscientific to point out that the nature of a cow is to eat plants, not animal parts, cement, wood chips, and feces.

** Craig's article on genetic engineering and world hunger appears as a chapter in the textbook, *Genetic Engineering*, edited by James D. Torr (Farmington Hills MI: Greenhaven Press, 2006). Part of a series on "Current Controversies," the book contains readings pro and con about human and agricultural applications of genetic engineering. Craig's article has also appeared in a German-language book, *Gefahr Gentechnik: Irrweg and Ausweg* (The Danger of Genetic Engineering: Wrong Way and Way Out). The book is edited by Manfred Grössler and published by Concord Verlag (Mariahof, 2005). Craig's article is available on our website at http://natureinstitute.org/txt/ch/feed_the_world.htm.

** Meanwhile, Steve's essay, "The Deceiving Virtues of Technology," has been requested for inclusion in a book of readings for technical writers. Scheduled to be published by Oxford University Press Canada in 2007, the book (according to its editor, Jennifer MacLennan) "is intended as a course text for upper-level courses in professional communication, and is meant to stimulate student thought and discussion about some important issues and challenges – ethical, philosophical, and social – that face the professional communicator." You'll find the essay at <http://natureinstitute.org/pub/persp/3/beast.htm>.

** Both Craig and Steve will have chapters in a forthcoming book from the University Press of Kentucky arising from the 2004 conference at The Land Institute, "Toward an Ignorance-Based Worldview." Craig's chapter is "Can We See with Fresh Eyes?" which you will find in this issue of *In Context* (see page 18). Steve's is "Toward an Ecological Conversation," a piece that has already been published in our online newsletter, *NetFuture*, in the journal *The New Atlantis*, and in our Nature Institute Perspectives booklet, *In the Belly of the Beast*. You'll find it at <http://natureinstitute.org/pub/persp/3/beast.htm>.

** Our preparations continue for another University Press of Kentucky book, this one consisting of a collection of writings by Craig and Steve (both individually and jointly) dealing with genetic engineering, biotechnology, and agriculture. We've been asked to expand the book by adding a section explaining the distinctive sort of science – a qualitative or Goethean science – that underlies the discussions we present in the main part of the book.

. . . And Face to Face

In August we hosted a three-day seminar at The Nature Institute on “meditative Goethean plant study.” The work focused on St. Johns Wort and Wild Chicory. The seven participants were guided in observation and inner picturing by Hugh Ratcliffe, who has done such studies for thirty years. Hugh works at Foyer Michael, an adult education center in France.

Craig in particular has continued to be extremely active in presenting talks and workshops and participating in conferences. His recent engagements have included the following:

** Talk on “Genes and Natural Contexts” at the New School for Social Research in New York City (May 23). Sponsored by the Center for Humans and Nature, the conference was attended by ecologists and philosophers from around the country. The overriding theme of the presentations and discussions was the history and multifaceted meaning of the ecosystems concept.

** Craig gave three plenary presentations on “Truth, Beauty, and Goodness” at the annual conference of the Biodynamic Farming and Gardening Association, held at neighboring Hawthorne Valley Farm in Harlemlville, New York, in August. About two hundred people from around the country attended. In addition, Craig gave two workshops, each attended by about forty-five persons, on “The Plant as a Teacher of Living Thinking.”

** From September 11 to 15 Craig taught three hours per day in the Holistic Science Master's Degree program at Schumacher College in England. He introduced the fourteen students to the Goethean approach to science and worked with examples from both plants and animals.

** While still in England, Craig visited the Ruskin Mill Educational Trust near Stroud, England. This is an innovative educational organization that provides learning

2006 Summer Course



The Nature Institute's 2006 summer course was attended by eleven people from around the country. As in past years, the focus was on applying Goethean methodology to plant study. This year we spent several days observing the milkweed plant (left). It required careful examination to

gain a vivid picture of milkweed's unusual and complicated flowers (bottom).



opportunities for young people who have difficulty fitting into traditional educational forms (<http://www.ruskin-mill.org.uk>). Founder Aonghus Gordon visited the United States last spring and met Craig. Aonghus has a commitment to bring the Goethean approach into all aspects of education. He invited Craig to give a presentation at a small working conference at Ruskin Mill concerning high school teaching. Craig also gave a public talk.

** “Guess What's Coming to Dinner: The Unintended Effects of Genetic Engineering” — this was the title of a talk Craig gave in Spring Valley, New York on September 29, sponsored by the Hungry Hollow Food Coop.

Our Fall Program

Here is a brief listing of the major events sponsored by The Nature Institute this fall. Please note that if you receive this newsletter by November 16, you will have time to attend the last event listed: the lecture, “Who Was Goethe, Anyway?” by John Barnes. We refer a great deal to Goethe and “Goethean science”; now is your chance to hear a biographical sketch of the poet and scientist by someone who has studied his life for many years.

Spectacular Tag Sale (SEPTEMBER 23)

The ultimate community recycling event – a benefit for The Nature Institute.

Genetically Engineered Food (OCTOBER 6)

Lecture by Craig Holdrege at the NOAH Center in Great Barrington, Massachusetts: “The Problem of Genetically Engineered Food: What Is It and What Can We Do?” Jointly sponsored with the NOAH Center.

The Healing Qualities of Bees (OCTOBER 20)

Lecture by Gunther Hauk. Co-founder of the Pfeiffer Center for Biodynamic and Environmental Studies in Spring Valley, Hauk has been a student of apiculture since the early 1970s and has developed practices and innovations for reviving the honey bee and strengthening its resistance to disease and parasites.

Workshop on Bees and Beekeeping (OCTOBER 21)

Following his lecture (previous item), Gunther Hauk led this all-day workshop.

Why Goethean Science? (NOVEMBER 2)

Lecture by Henrike Holdrege.

Who Was Goethe, Anyway? (NOVEMBER 16, 7:30 P.M.)

Lecture by John Barnes. Admission \$12 (seniors and students \$8).

** On October 21 Craig led a workshop at a Bioneers conference in Dartmouth. The huge conference featured presentations by various luminaries such as Paul Hawken, Lynn Margulis, Gunther Pauli, and Nancy and John Todd. Craig’s workshop explored how we can learn dynamic ways of thinking by studying living organisms and ecologies. Nature herself is whole and integrated, not fragmented, and our thinking needs to be adequate to this wholeness.

Being on Earth— A New Book

We have posted to our website the full text of an important new book, *Being on Earth: Practice In Tending the Appearances*, written by Georg Maier, Ronald Brady, and Stephen Edelglass. The book is a project of SENSRI, a sister organization of The Nature Institute located in Saratoga Springs, New York, and co-founded by Edelglass and Nature Institute affiliate researcher, Michael D’Aleo. After the untimely death of Edelglass and Brady, The Nature Institute

joined the project, and now the book’s publication is a joint venture of SENSRI and the Institute.

The subtitle of the book has two meanings:

The reader is being offered practice in *tending to* — looking after and heeding — the appearances.

The reader is also invited to *intend* the appearances. The meaning of “intend” is illustrated every time you make a choice.

The book was conceived as a phenomenological approach to knowledge — that is, a study of the world in terms of its immediate phenomena. Since the sciences, as they are presently constituted, are moving further and further away from sensible perception — chemistry, for example, may now be taught by computer without a laboratory component — the question arises, What is *lost* when knowing is separated from experience? In the academic classroom the answer to this question can sometimes appear to be “nothing,” but in actual practice, particularly in the field, researchers will often put stress on the need for a hands-on apprenticeship before the new member of the

team can even read the field manual properly. Practice as opposed to theory, still demands perceptual experience, but in stated theory there is no account of the component that only experience can provide.

In attempting to give such an account, the authors concentrate on three aspects of experience. The first is the mental activity by which we attend to a particular phenomenon — the activity by which we *understand* and *pick out* the phenomenon for consideration. The second is the *aesthetic* organization of phenomena. Phenomena are unified wholes rather than mere collections of parts, and the recognition of wholes is an aesthetic activity (as you can

readily understand when you try to grasp the unity of a great painting). The third aspect of experience the authors investigate is its ability to motivate the experiencing individual. Moral responsibility needs to be grounded in the *meaning* of individual experience, but this requires a recognition of meaning — hardly possible when the scientist is preoccupied with abstract, universal laws to the exclusion of those particular events that comprise our biographies.

Georg Maier is a physicist, as also was Stephen Edelglass. Ronald Brady was a philosopher. You will find the text of the book, along with further information about it and the authors, at <http://natureinstitute.org/txt/gm/boe>.

Thank You!

We are grateful to all of you who have contributed money, services, or goods to The Nature Institute between April, 2005, and the end of September, 2006.

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GOETHEAN SCIENCE STUDIES — SPRING 2006

Seven people participated in The Nature Institute's eleven-week course on the Goethean approach to science. Here's a glimpse into the course.



An exercise that teaches one to look more closely: drawing a white ball illuminated by a nearby lamp. The exercise is led by Martina Müller (above).

Participants experience what it is like to walk without use of their sense of sight (left).

The course participants and main leaders. From left to right: Craig Holdrege, Grace Worth, Cameron Genter, Andre Khali, Judith Madey, Sandragail Dunn, MaryBeth Merritt, Reinout Amos, Henrike Holdrege (right).



We celebrated the end of the course with an Open House. The students created displays showing some of their course-work (below left).

While Open House guests look on, student Judith Madey feeds her calf that lived on The Nature Institute grounds for a few months. Judith comes from Switzerland, is a mother, and has been a herdswoman at Hawthorne Valley Farm, adjoining The Nature Institute (below right). See Judith's article on page 13 of this issue.



The Other End of the Cow

Judith Madey

JUDITH MADEY was a student in the Institute's eleven-week-long spring course on the Goethean approach to science. Each student had an independent observation project. Judith, who worked with the cows at Hawthorne Valley Farm for ten years, chose to observe cows. This essay and the accompanying sketches are among the results of her studies. CH



Ever since I started working with cows ten years ago, I have been fascinated, intrigued, scared, upset, and amazed by these animals. My relationship to them changed over the years. It went from being frustrated about my inability to have any impact on them, such as when I was trying to convince them to walk out of the barn on cold winter days, to enjoying the quickness and lightness with which they charged down a particular hill if weather and air were just right. Mostly, though, I am filled with wonder every time I see how playfully, yet methodically they feed on grass. Seeing cows graze on a good piece of pasture gives me great joy and satisfaction, and watching them chew their cud has a calming effect on me.

One struggle in my project at The Nature Institute course was to observe an animal that I had worked with so closely for quite some time. Where do you start when it seems like you have seen it all? Luckily, it is quite easy to figure this out when you deal with cows: eating. Once I finally sat down for the first time to watch my young steer (a castrated bull) graze, I was immediately humbled. I realized how much I had superficially assumed and how much I had only read about, but never observed myself. After that initial observation, it was not hard anymore to figure out what to observe, and as I went along, there were more and more questions, not fewer.

The group I was observing consisted of two young animals of my own and ten that came from the farm I had bought mine from. I tried to go out to my little herd almost every day for at least ten minutes. I often took my sketchbook along to make some simple line drawings. Back home, I would at some point during the day take the time to remember what I had seen, painting as clear an inner picture of it as I could. This proved to be a crucial step to gain-

ing any insights and was a fundamental aspect of the goethean approach as taught to us by Craig Holdrege. I then would return the next day to attend to what I had not been able to picture clearly. Often, I would also just soak in the animals in their surroundings and try to do some simple line drawings.

In the whole process of observation and repicturing, I realized that actual insights can't be forced. Instead, they show themselves to us in unexpected moments and are a gift. They appear much like drops of dew on a crisp morning, easily overlooked, but each containing a little gem.

The Grazing Cow

Cows are not particularly elegant animals. They have nothing of the grace that cats display. They are not affectionate and loyal like dogs. Nor do they have the expressiveness of pigs. They definitely are not nervous like mice scurrying around, nor are they smart like goats. Just looking at them, one would not call them beautiful, at least not compared to a lion or a horse. Everything about them shows weight, heaviness, and downwardness. "A big box on sticks" somebody told me, and in that context, "they are easy to draw." Well, that latter statement made me look twice — cows are actually very hard to draw, as other people have confirmed.

After giving the cows a new piece of pasture (which I did about every four days), they usually were very eager to eat. They would put their head down as soon as they were on the new grass and focus their entire attention toward the activity of carefully selecting the best grasses. Superficially it looks like they are just chomping down the grass indiscriminately, their head moving each time they take a bite. However, I was surprised to see how carefully their

tongue wraps around what they want to eat. If anything they do not like enters the mouth, they immediately work it back out, although this reverse movement is not so easy. The cow usually looks as though she is making funny faces.

The tongue is very active during grazing. It moves out of the mouth, wraps around the grass, and rips it off. The grass enters the mouth and gets swallowed without much chewing. Watching cows eat hay in a barn setting, it looks like a continuous stream of hay is entering the mouth. On pasture, this stream is a bit more interrupted since the cows need to rip off the grass. A quick and subtle, but very clear upward movement of the head assists this movement of ripping. The cows also move along as they graze. They take about three to five bites for every step.

The activity of the nose becomes more pronounced as the grazing continues. As the cow gets less hungry, she spends more time just sniffing. The eyes are directed forward, the ears point to the ground, and the legs move the body along in a rhythm determined by the activity of the tongue. Even the legs seem to “point” forward. On a certain level, the whole cow takes part in the grazing.

Cows make many passes across a field, grazing one area multiple times. It is hard to see a feeding trace after just one pass; it looks as if they have not eaten anything. The cows seem to just bite the tops off for a while. But at some point the whole pasture looks grazed down. I was fascinated by the intricate movement pattern the cows engage in while eating. They hardly ever stand still during grazing and rarely move in a straight line for very long.

The herd moves together to the watering place unless the water is very close. There is a moment in which all of a sudden movement comes into the herd, directed less by the grass than by the need to drink. The grazing continues, but there are more steps between bites. Often salt is taken in at this time.

The Resting Cow

Often, when I arrived mid-morning or at noon, the cows were lying down. They were usually all near one another — little clusters of two or three animals in close proximity, with bigger distances between clusters. These little clusters often consisted of animals that had been raised together in small groups as calves, while they were still being fed milk.

Resting, the cows still express a heaviness. The head is up, but it leans toward the earth; it is heavy. Smaller animals often curl their heads in toward their bodies or lie stretched out on their sides. Older cows usually lie with

their head up. Finding an older cow stretched out or with her head curled in is usually a sign of illness.

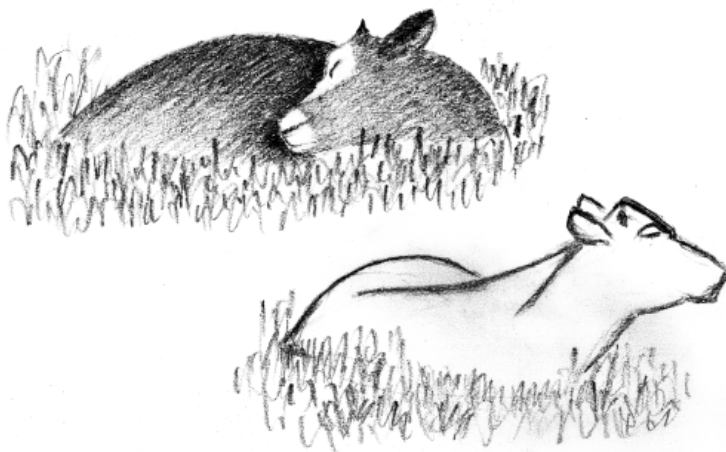
When a cow lies down, it is not a graceful movement. She goes down on her front limbs first, one after the other. Then she folds in her rear legs. About six inches above the ground, she lets herself fall, giving herself over to gravity. It always looks very awkward to me, as if a cow’s legs were not really suited for lying down or getting up.

In pathological conditions, for example after a hard birth, cows may be unable to get up. This is a worrisome time for the farmer because he or she knows only too well that if that cow does not get up soon, she will never get up again. The heavy weight of the body crushes the muscle in the legs. It is quite a job to deal with these animals, since it is not so easy to turn them from side to side to avoid tissue destruction (necroses).

While lying, cows are usually quite alert, which shows in their ear movement. The ears will turn to where a noise comes from. But occasionally, when I found them lying down, I had to call on them a few times to get any reaction. They seemed to be deeply asleep. They seemed a bit embarrassed once they realized how close I had gotten.

They usually chew their cud while lying. One piece is propelled up from the rumen through the throat to the mouth, moving against gravity. Once there, it is subject to sideways chewing. The cow will rechew a bite fifty to sixty times before it goes back down. The next one comes up in no time, and again gets chewed fifty to sixty times.

To get up, a cow pushes up with both its hind legs. Then it puts one front leg down, and then the other. It looks to me as if it is not as much a pushing up of the body as a pushing away of the ground.



Social Interactions

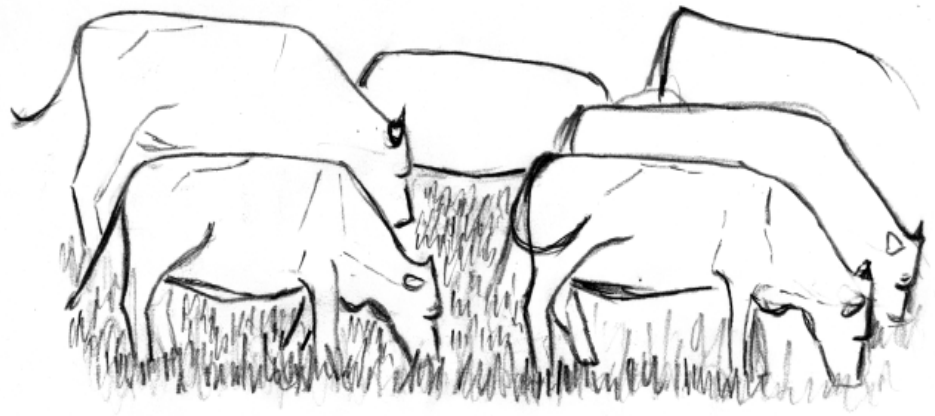
Working with older cows, I had often observed fighting whenever I joined new cows into an existing group, even if earlier the new animals had been part of the herd. There is a clear sequence to the fighting: first two animals approach each other sideways, with heads down. Next they lock heads and push against each other with tremendous force until one gives way and turns around to run away. The other animal chases her for a period of time, never very long. Often, the strongest animal of the existing group picks the first fight, followed by the next strongest one. The weaker ones usually fight the longest.

When I introduced my two steers to the group of heifers that became my little herd, I expected to see this kind of behavior. Some animals definitely fought, but I also watched a lot of mutual licking and moving around together. It took me a while to figure out what was going on. Since both my steers had spent their first four weeks on the farm the heifers came from, they had spent that time together with some of the animals now present. These animals did not fight with each other. Instead they went right back to the formerly established order. They had recognized each other, despite the separation spanning weeks.

The bond of calves that grow up together is a strong one. They tend to graze in close proximity and like to move close together when the whole herd is moving. I have noticed cows getting lost when they came into the barn the first few days after I had shipped off a cow they grew up with.

Once the relationships in my little herd were established and all the animals were used to eating grass as opposed to hay, they became one group, a herd. There is something magical about a herd. Each individual animal moves along its own path or occupies its own space lying down, yet it does not fall out of the context of the herd. Seeing a cow by itself apart from the herd is unusual. In fact as a herds-woman, as soon as I would see an animal by itself, I knew there was trouble. The “trouble” of finding a cow calving was usually a pleasure, finding a cow sick not.

Watching the herd graze, I observed a few times in their movement something similar to what we had studied about the growth of plants: expansion and contraction. The leading animals would walk ahead while the last ones still stayed behind, and the group would become strung out. Then the



back ones would start to close in, bringing everybody along until the group had become much tighter, at which point the leaders started to spread out again.

Much of the interaction between the individual animals happens through mutual licking. In fact, the tongue is part of everything a cow does: she eats by ripping the grass off with her tongue; the tongue moves the cud back and forth during the resting time. A cow licks her calf as soon as it is borne. Older animals interact with each other by licking each other. The bull licks the rear end of a cow to make her urinate so he can smell whether she is in heat. He will lick her around the shoulder blades to settle her down so he can breed her. The rhythm of the cow moving as she grazes is determined by the activity of the tongue.

Relations to Qualities in the Environment

The cow stands on the ground with its four feet. It feeds from the ground; its head is directed toward the earth when grazing. Its body is big; I often wondered how these thin legs could ever carry such a heavy weight. The rump hangs down; it is wider at the bottom than the top. Even the tail hardly ever goes higher than the back. If it does it is merely in annoyance at the flies. Every thing speaks of weight.

One morning I came early and just knew I had to go watch even though I had a lot of pressing things to do. As I approached the pasture I became aware of two deer grazing in the paddock adjacent to the heifers. As they saw me, their heads went up – way up! How little effort it took those deer to lift their heads! And when they bent back down to graze, it looked like they had to actively put their head down, much more actively than the cows.

For all the heaviness that the cow shows in her body, there is also an expression of a force going the other way: for one,

the horns grow up. Then, whenever the cow swallows, the food is brought into the rumen against gravity. And when the cow chews her cud, again the food moves against gravity from the rumen to the mouth.

Cows that are not fed minerals and especially salt become lethargic and unresponsive. There was another group of heifers across the road from the ones I was primarily observing. For a while this spring, they seemed to graze aimlessly, there was no coherence to their behavior. I asked the woman who took care of them if they had salt, which prompted her to go get some. When I came back the next morning, I had forgotten about my conversation with her. I was struck by the difference in behavior of the animals, though, and then remembered what we had talked about. The heifers were much more alert, moved more purposefully, and looked up when I came close and interacted with each other again. Salt seems to be important for other ruminants, too, more so than for other species of animals. I do not really worry about feeding my cat or dog any salt, but I definitely think about it when it comes to cows.

The cow takes the salt in with her tongue, carefully licking up small amounts. In between, she licks all around her mouth and will extend her tongue into her nostrils and clean any salt away that might have collected there.

Cows do not like to have wet feet. They would much rather stand on dry ground. In rain, they all turn away from the direction of the rain, arch their backs, huddle together, and wait for better times. A clean water source for the cows to drink from is a very crucial part of keeping them healthy. Lactating cows drink up to thirty gallons of water a day. Cows also develop a tremendous amount of saliva every day, and they circulate many pints of blood to produce one pint of milk.

On hot days, the cow needs to drink water to cool down. She takes the water in through her mouth by suction. The tongue is not as active while drinking as while eating. The water moves through the body and is excreted at the other end. The cow perspires some, but she mainly cools down by drinking and excreting.

From what I have observed, breathing is not developed as strongly in the cow as in a dog, for example. It's something that more or less happens to the cow, not something she takes up as an activity. The big digestive system can easily put weight on the lungs. For this reason, cows would rather stand facing uphill than downhill. In that position, the weight of the digestive organs pushes toward the tail, away from the lungs, and makes breathing easier. Again, the cow lives strongly in gravity.

Cows are also very sensitive to the quality of the air. If the air gets stuffy in a barn, too humid, too warm, the cows will

very quickly get sick. I had a barn full of cows with diarrhea once, and another time I had a pneumonia outbreak, just because the temperature went up over night when I thought it was too cold to leave the fan on. I would rather deal with frozen pipes than sick animals, and so I started running fans more often.

Cows get pneumonia easily if some water gets into their windpipe. They cannot really cough, and they show general distress most strongly in their breathing. They are also very sensitive to wind.

Cows see, but a visual impression usually gets verified by sniffing, or even licking, the object. Depth perception is minimal. Sometimes a cow refuses to go under a fence held high or step over a wire put on the ground. To them, the fence seems to be a vertical plane; as soon as it is out of the way completely, the cow walks through without hesitation.

A change overnight in a visual appearance can affect cows strongly. I have experienced the whole herd being turned around by the lead cow because the neighbor put a tablecloth on a table where there had been no tablecloth for weeks before. The same neighbor hung out some laundry after the cows went out. On their way in, some of them spooked and I literally had to take down the pants hanging there to get them to the barn. Anything dark, especially black, makes them hesitate to walk by. The sense of sight is not as refined as the sense of smell and taste. The fact that anything new takes a long time to get used to again suggests heaviness. Dealing with cows, I really learned to slow down. It just does not help to hurry and force them.

Cows have another, more indirect but essential relation to air and light: I mean their relation to grasses. The short description of grasses that follows does not do justice to them, but may at least hint at the relation to air and light I sense.

Grass has long, narrow, blade-like leaves that do not really unfold. Looking at them, one can see that at least half the leaf stays rolled up around the stem. Grasses show amazing strength in holding their stem upright. The flower emerges through the stem. One can find it fully formed early on if one carefully slits the stem open in the middle of May. The flower is nothing spectacular at first sight. There is not much color, the flowers are small and inconspicuous. The plant seems to be all about stem.

Grasses rarely grow alone; they form a strong community and cover a lot of ground. By the way they grow, they allow other plants to grow alongside them: They do not create much shade and often help support other more vine-like plants. Often we find clovers alongside them, but also many other flowering plants.

Grasses grow up straight to the sun and bloom just before and around St. John's Day (June 24) when the days are longest and the light is strongest. Their pollination happens by the wind, unlike many other plants that are pollinated by insects. It is an amazing sight to see the wind move across a meadow and see the ripples it creates on the many, many grass plants. To me, grasses live in light and air.

When the cow eats grass, she takes into herself the light and air as the grass expresses it. Looked at in this way, the cow takes in air and light through the activity of her tongue and mouth in a manner similar to how she takes in earth and water.

Conclusion

I don't think I will ever look at a cow the same way as before. We farmers often deal with the rear end of the cow — probably eighty percent of our time is spent milking the udder, scraping manure off the floor of the barn, and taking the manure out. We do feed them, but often the cows are not in the barn when that happens. Often we know a cow better when we see her udder than her face. When I look at cows now, fully knowing the importance of milk and manure, I also see “tongue” — the other end of the cow — as a place where the cow intensively meets the world.

(Continued from p. 7)

This is the very act that produced an object for mathematical physics. After all, the primary qualities are numerically measurable, while the others are not. But to venture further and treat the resulting division as a distinction between what exists “externally” — independently of the observer — and what does not is another matter entirely. Here something has been added to the original distinction between primary and secondary that is not derivable from the distinction itself. We have no a priori knowledge that only the measurable is real (“out there”) and the rest merely subjective (“in here”). During the Renaissance, however, for reasons that pertain to the times, Galileo's distinction was given just this significance. (For discussion of this historical development, see *The Marriage of Sense & Thought* by Edelglass, Maier, et al. 1997.)

Of course, for the Renaissance mind as well as the modern, the lawful mathematical relations revealed through measures testify to an underlying reality. This conclusion derives from equating the independently *real* with the *lawful*, a fundamental premise of Western thought.

The equation of real with lawful, however, says nothing about what qualifies as lawful. Thus it does not follow that what is not numerically measurable is also not lawful. Yet this second judgment was added to the first, and the West after the Renaissance adopted a worldview that fosters a deep split between theoretical knowledge and experience. This view assigns external, lawful, and independent existence only to the world measured in terms of primary qualities. It demotes to a contingent existence, dependent upon the individual observer, everything left over after the

primary information has been abstracted. This demotion is what I meant by remarking that the truth of the measure does not provide a context adequate for specifying the meaning of the measure. The discovery of a lawful reality permitting mathematical treatment says nothing about the remainder of experience that does not permit such treatment.

The assumption that “lawful” is identical with “measurable” is often entertained today and it still, for many thinkers, serves to distinguish individual subjectivity from independent reality. In general, scientific methodology still depends upon measurement of primary qualities, and, since those qualities are assumed to be independent of the observer, it uses methods of measurement that either omit the observer entirely (by substituting mechanical devices) or attempt to escape subjective variation by generalizing on the reports of multiple observers. Immediate experience is *individual* — not a good candidate for what is normally termed “scientific observation” — and far richer than its measured relations. So “scientific observation” represents but a small part of the original content.

Left over when the scientific information has been abstracted is the part of experience that, like colors or sounds, cannot be known except through direct experience. The majority position holds that a direct connection to individual human consciousness disqualifies this portion of experience from scientific investigation. But there is a minority position, and we have found a historical thread of opposition to the majority position running from its inception in the renaissance to the present day. After all, an exhaustive equation of law with numerical measurement is a weak premise — hardly something that will stand up to direct experience.

Can We See with Fresh Eyes?

Beyond a Culture of Abstraction

Craig Holdrege

This essay is based in part on a talk Craig gave at the Land Institute's Prairie Festival in September, 2005. The essay will also appear as a chapter in a forthcoming book, In Defense of Ignorance: Prospects for a New World View, edited by Bill Vitek and Wes Jackson (see news item on page 8 of this issue).

The problem with biases is that we often don't know we have them or how strongly they inform the way we view and act in the world. I want to address one fundamental bias that infects modern Western culture: the strong propensity to take abstract conceptual frameworks more seriously than full-blooded experience. We all too naturally speak of the world in terms of genes, molecules, atoms, quarks, neural networks, black holes, survival strategies, or other abstract concepts. These are felt to be more "real" than the phenomena of nature we experience — the radiant, blue-shimmering Sirius in the winter sky or the deep blue chicory flower that opens at sunrise and fades away before noon.

I suggest that the more we place abstractions between ourselves and what we encounter in the world, the less firmly rooted we become in that world. The maize that feeds our cattle, pigs, and chickens — grown on immense fields of the Midwest, doused with fluid fertilizers that contaminate wells and contribute to oxygen deprivation and death in the lower water layers of the Gulf of Mexico — this maize is much more than a nutrient-generating genetic program modified by human artifice. Viewing maize in such restricted, abstract terms, isolated from its larger reality, is what leads us to overlook — at least for a time — the "unfortunate side-effects" of our approach. Is it any wonder that a culture caught in a web of abstractions becomes a culture disconnected from nature and destructive in its actions?

In this essay I want to show some ways to move beyond a culture of abstraction. Since the first step in overcoming a firm habit of mind is to acknowledge its existence, I will call attention to the problem of abstraction itself. Then I will describe how we can open up our perceptual field by trying to put the conceptual element in the background. This entails acknowledging our ignorance and maintaining an

ongoing sense of ignorance — and thereby intellectual modesty — in all our undertakings. Finally, since we cannot do without concepts, we also have to work on transforming them. This demands changing not only the content of our concepts, but also their form or style. I will describe how we can develop what I call living concepts through which we can become more connected to the rich fabric of the phenomenal world.

Captured by Abstractions

The capacity to abstract is what allows us to pull back from our perceptions and look at the world as if from a distance. We can form clear and distinct conceptions about things, form judgments, and then act. In this respect the ability to abstract is a central feature of being human. But like all gifts and strengths, our capacity to form abstract concepts is a double-edged sword when it becomes too dominant and habitual. If we do not consciously attend to how we form abstractions and then remain aware of their relation to experience, they tend to take on a life of their own. As a result, we run the danger of attending more to the abstractions themselves than to the world they are meant to illuminate. In this essay I focus on this shadow side of abstraction.

Here is an extreme description of the world in terms of abstractions by the contemporary philosopher Paul Churchland:

The red surface of an apple does not look like a matrix of molecules reflecting photons at certain critical wave lengths, but that is what it is. The sound of a flute does not sound like a compression wave train in the atmosphere, but that is what it is. The warmth of the summer air does not feel like the mean kinetic energy of millions of tiny molecules, but that is what it is. (Churchland 1988, p. 15)

For Churchland "reality" — the "is-ness" of things — consists of the high-level abstractions of science. The apples we see and taste, the melody we hear, and the warmth we sense are all only appearances, mere subjective semblances of true physical reality.

And what about our own inwardness? Neuroscientist Antonio Damasio, writing in *Nature*, has an answer:

An emotion, be it happiness or sadness, embarrassment or pride, is a patterned collection of chemical neural responses that is produced by the brain when it detects the presence of an emotionally competent stimulus. (Damasio 2001, p. 781)

So, on this view, the world we experience — all the colors and sounds, smells and tastes — are phantoms of moving molecules, and the joy of eating juicy grapes is “in reality” a chemical response of the brain. This way of viewing things is widely pervasive in science, science education, and science journalism. In one way or another it comes to inform the way most people today learn to think about the world.

When we raise abstractions onto the pedestal of “primary reality,” we have forgotten how such concepts arise. Concepts such as “molecule,” “atom,” or “chemical neural responses” develop as the thinking human mind questions the phenomenal world and interacts with it through the experimental method. These concepts are woven out of a rich fabric of theory and experience. When we focus our attention only on the end result, isolated from the rest of the process, we end up with thing-like concepts of atoms and molecules. The problem is that scientific training often does not teach us to pay attention to how concepts are formed. Rather, since we usually learn them as abstractions already separated from their genesis — from their actual scientific and human context — we view them as if they were object-like facts of the world, more real than everything else because they can be so clearly conceived.

This essentially unconscious process of reification is what the philosopher Whitehead called the fallacy of misplaced concreteness (Whitehead 1967, pp. 51 ff.). We treat our abstractions as concrete things of the world. I simply call it object thinking — thinking of the world in terms of objects (Holdrege 1996). The way most people — including scientists who could know better — talk about genes, molecules, hormones or brain function reveals such object-thinking.

So what’s the problem with such a way of viewing the world? First of all, it erroneously suggests that when scientists talk about the world-as-abstraction they are talking about the world as a whole. What we actually experience — which is not molecules, genes, and firing neurons — becomes a subjective phantasm: the blue of chicory is “only” a particular light wave, water is “only” H₂O, your feelings are “only” your hormones busily at work. Why, in the long run, should we take interest in a world that is “only”? What moral commitment can I have to genes, mol-

ecules, and hormones? So one problem with the abstract world view is that it disconnects us from the very world it sets out to explain.

As the physicist and educator Martin Wagenschein emphasizes, we all too easily ignore the fact that to take a reduced view of the world is a choice (Wagenschein 1975, pp. 135-53). Physicists have made the choice to view everything in terms of quantities and to mathematize the phenomena. Geneticists have chosen to view heredity in terms of particulate causal entities (“genes”). What these sciences end up with is not a description of the world but a description of one aspect of the world in highly abstract and reduced terms.

As a consequence, conventional modern science and the technologies derived from it address isolated aspects of a much richer fabric of reality. Since this limited perspective of science is often overlooked, we fall into believing that science is addressing *the* problems of *the world*. Nothing is more dangerous than the illusion of thinking you have a solution to a problem (a gene to cure a disease; a pesticide to kill a pest), when you have framed both the problem and the solution in overly narrow terms. Given that things play themselves out in complex relations, such solutions may even exacerbate the overall problem (the “cure gene” disrupts other physiological processes; the pests become resistant to the pesticide). As Amory Lovins puts it, “if you don’t know how things are connected, then often the cause of problems is solutions” (Lovins 2001).

David Bohm points out that since scientific concepts and theories lead to a fragmented view of the world (organisms consisting of molecules, molecules consisting of atoms, atoms consisting of elemental particles, and so on) we come to act upon the world in a fragmented way:

If we regard our theories as “direct descriptions of reality as it is,” then we will inevitably treat these differences and distinctions as divisions, implying separate existence of the various elementary terms appearing in the theory. We will thus be led to the illusion that the world is actually constituted of separate fragments and ... this will cause us to act in such a way that we do in fact produce the very fragmentation implied in our attitude to the theory.... So what is needed is for man to give attention to his habit of fragmentary thought, be aware of it, and thus bring it to an end. Man’s approach to reality may then be whole, and so the response will be whole. (Bohm 1980, p. 7)

Whether we speak of abstraction, fragmentation, isolation, or reductionism is not so important, since each of these terms points to a different nuance of the same habit of mind. What is important is to overcome the habit. If we don’t, we

will continue to produce myriad unintended effects that contribute to the ecological, social, and economic problems dominating our times.

The Conundrum of Knowledge

Recognizing the power of abstractions to catch us in their web, the philosopher Edmund Husserl — already nearly 100 years ago — made an impassioned cry for a “return to the things themselves.” But this return — or perhaps better said, forging ahead — to the things themselves is no easy task, as Husserl describes in *Ideas: General Introduction to Pure Phenomenology*:

That we should set aside all previous habits of thought, see through and break down the mental barriers which these habits have set along the horizons of our thinking ... these are hard demands. Yet nothing less is required. What makes ... phenomenology ... so difficult is that in addition to all other adjustments a new way of looking at things is necessary, one that contrasts at every point with the natural attitude of experience and thought. To move freely along this new way without ever reverting to the old viewpoints, to learn to see what stands before our eyes, to distinguish, to describe, calls ... for exacting and laborious studies. (Husserl 1969, p. 39)

So how can we learn to see with new eyes, to re-ground our knowing in the world of lived experience rather than in enticing but tenuous abstractions? We can begin by realizing the virtues of ignorance. Henry David Thoreau describes beautifully in his *Journals* the role of ignorance in knowing:

It is only when we forget all our learning that we begin to know. I do not get nearer by a hair's breadth to any natural object so long as I presume that I have an introduction to it from some learned man. To conceive of it with a total apprehension I must for the thousandth time approach it as something totally strange. If you would make acquaintance with the ferns you must forget your botany.... Your greatest success will be simply to perceive that such things are, and you will have no communication to make to the Royal Society. (October 4, 1859; in Thoreau 1999, p. 91)

I must walk more with free senses — It is as bad to study stars & clouds as flowers & stones — I must let my senses wander as my thoughts — my eyes see without looking.... Be not preoccupied with looking. Go not to the object let it come to you.... What I need is not to look at all — but a true sauntering of the eye. (September 13, 1852; in Thoreau 1999, p. 46)

To help us learn this “sauntering of the eye,” Thoreau, who was no reticent person, might well have taken us on walks and prodded us with his walking stick to just look, just smell, just hear — and rid ourselves of all our confounded knowledge. But, he was also not simple-minded; he knew there was more involved in knowing:

It requires a different intention of the eye in the same locality to see different plants, as, for example, Juncaceae [rushes] or Gramineae [grasses] even; i.e., I find that when I am looking for the former, I do not see the latter in their midst.... A man sees only what concerns him. A botanist absorbed in the pursuit of grasses does not distinguish the grandest pasture oaks. He as it were tramples down oaks unwittingly in his walk. (September 8, 1858; in Thoreau 1999, p. 83))

Thoreau realized that we don't see anything unless we have concepts, unless we have an intention that we bring to the world; otherwise we would just have confusion. I was once walking along and saw something black moving across the path in front of me. I couldn't “get it.” I saw something but had no idea what it was. That was disturbing. I tried the concept snake, but it didn't take, and then suddenly I saw it: a black plastic bag blowing over the path. The perceptual world, for a moment in disarray, had come together again. Only if I bring concepts to experience, do I see coherently.

So there is a problem: the openness and freshness — the ignorance — that allows us to perceive things that don't fit into our preformed ideas and thereby to see the unexpected, on the one hand; and on the other hand, the necessity to bring the fruits of previous experience to illuminate the phenomena we are perceiving. We need openness to take in something new, but only through applying concepts formed from previous experience — which are in this sense biases and can often be quite abstract — can we make sense of the world at all.

So there is a real tension between pre-formed concepts and openness. I would say that we need to live *actively* and *consciously* within this tension. We need the awareness that gaining knowledge is always a matter of our engaging in the world from a particular perspective. In this way we become more sensitive to the boundaries of our knowledge and more aware of the extent of our ignorance.

But there is the further question of the quality of our concepts, of what we bring to our experience. Can we transform our concepts so that they become less abstract and more vitally related to experience? Can we move from conceptual biases that color phenomena to more malleable concepts that become sensitive tools to illuminate the not-yet-seen? Can we

be just as interested in what does not fit into our scheme of things, as in what does? Can we continually stretch and remold our view of the world? Or to put it another way: Can we bring new life into our way of knowing?

Cultivating Openness

Over a number of years I studied a particular plant, the skunk cabbage. I was intrigued by its strangeness and wanted to get to know it better. So I went out regularly and observed it, and got to know its habitat, life cycle, and how it adapted to its environment. I'd often go out with a particular question and focus.

But I also made it a rule to occasionally go out with no fixed focus and try to perceive with Thoreau's sauntering eye. Sometimes it didn't work because my attention would wander inward and I'd start thinking about all sorts of other things. Although I was out in the woods, I was in my head and hardly seeing anything. But sometimes it worked, and I could tell that repeated practice makes it possible to cultivate a kind of open, receptive awareness infused with an animated expectation of what might come toward me.

One March afternoon I went down to the wetland where skunk cabbage grows. In upstate New York where I live it often is still wintry at this time of year. On this day the sun was shining through the leafless shrubs and it warmed my face. My eyes were wandering over the skunk cabbage flowers I knew so well that were just emerging from the cool muck. Then I saw a few bees. I watched those bees fly into the flowers and fly out again into other blossoms. In a flash I realized, I hadn't seen any bees yet that year. The first bees of the year were visiting this plant — this strange plant that warms up to over 60 degrees when it comes out of the ground, even though the air temperature is often at or below freezing. Skunk cabbage warms up, and on a first somewhat warm and sunny afternoon, the bees come.

I'm pretty sure I would have overlooked this wonderful meeting of bee and skunk cabbage had I not been practicing a "sauntering of the eye." I know myself well as a not-so-open observer and as someone who usually has to focus intently to see. But that very focus can prevent me — and certainly often does prevent me — from seeing the unexpected. So, by going out purposefully with the broad focus of open expectation, I overcome my limitations and invite the world in.

Another exercise to heighten openness is to pause during the evening and think back over the day. "What did I experience today that I wasn't expecting?" It can be disheartening to realize how much of what I experienced was actually expected. Biases were supported: the colleague who is usu-

ally a jerk was once again a jerk, and so on. To cherish those few moments when something new and unexpected appeared, and then to vividly and concretely re-picture those experiences to myself can lead me to cultivate an interest in and sensitivity to the unexpected. So I can reflect back on my troublesome colleague's actions and words that *did not* fit my expectations. I try to create a field of openness. It actually does bear fruit. I can begin to see another person, a landscape, or a social problem — whatever it may be — with fresh eyes.

Beyond Abstraction to Living Concepts

Most people think giraffes have long necks. I used to teach, as many biology teachers do, about how the giraffe got its long neck through evolution. The giraffe — as long as I considered it solely in terms of the "fact" of its long neck — was a straightforward illustration of how Darwinian evolution via variation and natural selection works. I was disseminating "knowledge," but did this knowledge really illuminate the giraffe?

Later I studied the giraffe and its neck in more detail. Since I wasn't interested in any particular theory or explanation and just wanted to get to know the giraffe better, I was open to what the wealth of phenomena had to show me. They showed my ignorance and the poverty of the concepts I'd been using. As a result, the concept of the giraffe's "long neck" increasingly became an abstraction to be overcome.

The first step in overcoming this abstraction was to view the neck both within the context of the whole animal and in comparison with other mammals (Holdrege 2005). I discovered that the neck is not the only long thing in the giraffe. The giraffe has very long and straight legs. Since the foot and leg bones are not only long but also arranged more vertically than in other hoofed mammals, the overall leg length is increased significantly. Moreover, the giraffe is the only hoofed mammal that has longer front legs than hind legs. It has a long head, a very long tongue and long eyelashes too (and at the other end the tail hairs are the longest hairs you'll find in mammals).

Since the giraffe has a markedly short body in relation to its height — a beautiful instance of what morphologists call compensation — both the neck and the legs appear even longer. I realized the giraffe's neck is part of an overall tendency in the animal toward vertical lengthening, especially in the front part of the body. All the limb-like parts of the body — the four legs, the neck as a limb for the head, the jaw of the head, and then, of course, the tongue — are long

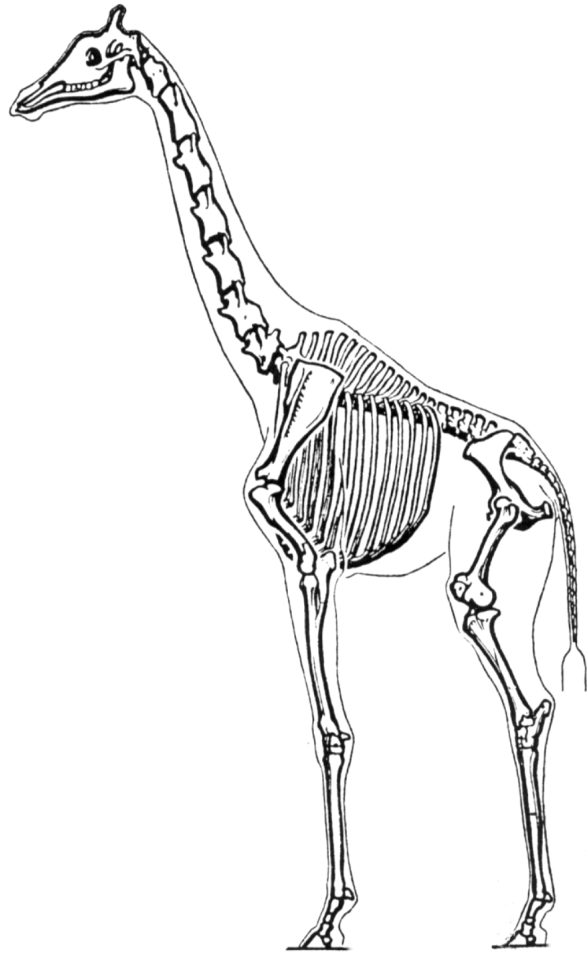
and through their particular configuration allow the animal, for example, to reach high into trees to browse.

So what is the matter of fact about the giraffe's long (or short) neck? We come back to what I said before: if a fact is to be more than an isolated abstraction, we need to view it within a context. And in the case of the giraffe's neck, the context is the organism itself. Morphologically, the long neck is an exemplary feature of its unique body in which all parts speak long and skywards. But when the giraffe lowers itself to the terrestrial level, its neck becomes short — an expression of the long-legged animal whose neck attaches so far up on the trunk that its head can no longer reach the ground. But this all has consequences. A giraffe is not only concerned with the world from six to sixteen feet up, where it feeds and browses. It sometimes lowers its head to drink and graze. Then it does something quite strange. It must spread its forelegs awkwardly far apart, making it more vulnerable to predators. Only then can its mouth reach earth or water. The giraffe has a manifestly short neck! What other hoofed mammal has a neck so short that it cannot reach the ground without spreading its legs?

When we frame our questions in abstract ways — what is the cause of the giraffe's long neck? — we have already decided that there is *one* cause and that the giraffe's neck *is* long. We have a terribly oversimplified framework in which we study the animal. The trouble is that we usually don't make the effort to view things within their dynamic, changing contexts. There are lots of stories about how characteristics of organisms evolved, but these stories "work" only as long as you treat the beak, the fin, the feather or the stomach in isolation from the whole animal. So becoming sensitive to how our concepts inform what we see is important. Without this awareness we end up explaining schemas and not addressing the things themselves.

What we can do is become more playful with our concepts. When I see the giraffe both in terms of its "long neck" and its "short neck" I overcome a predilection to look at it in just one way and don't get stuck within a too-narrow conceptual framework. And at the same time I begin to appreciate more deeply the organism's complexity. To do justice to this complexity I need to take multiple perspectives. I might not end up with a neat, unified explanation of the animal, but at least I have met the richness of the creature rather than having created an abstract phantom.

As the German poet and scientist Goethe remarked, "If we want to achieve a living understanding of nature we must follow her example and become as mobile and flexible as nature herself" (Goethe 1995, p. 64). I have come to realize how organisms can teach us about a living, dynamic way of thinking. If I'm willing to pay attention I can learn from life



how to think in a living way. For me the study of the growth and development of plants has become an especially vivid and rich model for what I would call living thinking.

A growing plant sends roots spreading intimately through the soil, taking in and exchanging with the earth. These are qualities we, too, possess when, as sensory beings, we explore and meet the world with fresh eyes. Always growing, always probing, meeting things anew, we become rooted in the perceptible experiential world.

As a flowering plant grows, it unfolds leaf after leaf (a process you can see most vividly in annual wildflowers). When the plant grows up toward flowering, the lower leaves die away. So a plant lives by unfolding something very important at that moment, then moves on to make new structures while past forms fall away. What a wonderful guiding image of how we can work with our concepts: instead of falling in love with a particular conception and holding on to it at all costs — object-thinking — we could learn to form a concept, use it, and then let it die away as our experience evolves. Our deeply felt sense of our own boundaries and ignorance allows us to keep knowledge alive, open, and growing. A plant shows us what it means to

be undogmatic. Or to put it positively: how to stay dynamic and adaptable.

You can also read the environment by studying a plant's form. A plant develops differently in drier or richer soil, in shady or brighter light. A plant is always in context. If we were to think plantlike, our concepts would stay closely connected to the context they arose from, and if that context changed, we would drop or metamorphose our ideas to stay within the stream of life.

In practicing this kind of knowing we can experience ourselves as active, but also receptive participants in an ongoing, evolving conversation with nature. We participate even as knowers in the world. We are no longer distant onlookers gazing coolly at a world of objectified things. While gaining this re-connection and rootedness in the world is exhilarating, it is not necessarily comfortable. One of the comfortable things about object-thinking is that because we view the world as consisting of things and have taken on the task of getting at the underlying mechanisms, we can manipulate things at will. Science becomes a kind of value-free zone. But the moment we become aware of the participatory, interactive nature of knowing, everything changes. Entangled in the world at every moment, we know that we bear responsibility for our way of knowing and its externalization in our technologies and actions. A living thinking is a thinking that knows itself as embedded in the world. It is also a thinking that knows it does not have "the answer."

Conclusion

If we are interested in a new kind of culture, then it won't do to simply tweak the old forms. We need a revolution. Just as the scientific revolution has radically changed the way people view and relate to the world over the past four hundred years, so do we now need a new revolution in world view that increasingly bears fruit over the next four hundred years.

Seeds of this transformation are created every time we catch ourselves considering a problem or phenomenon through some pre-formed conceptual lens and then drop that lens and turn back, in openness, to the things themselves. In this act we acknowledge our ignorance and show ourselves ready to engage in the concrete situation. With heightened awareness we can begin forming concepts out of interaction with the world rather than imposing them upon the world. This is living thinking.

Imagine more and more people cultivating this approach — which is modeled after concrete, living phenomena — rather than striving toward ever greater abstraction in

thought (the goal of goals being a unified theory of everything). It will be, at first, a quiet revolution, taking root in the minds of individuals and unfolding in small organizations. But what else would we expect from a revolution modeled after plants? They make no great stir as they go about their radical work of enlivening the world we live in. The shift from abstraction and object-thinking to a plantlike dynamic thinking would help us develop the capacities we need to truly root our understanding and our interactions with nature in nature.

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