In Context

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The Newsletter of **The Nature Institute**

#10

Dear Readers,

With the publication of this tenth issue of *In Context* on the fifth anniversary of The Nature Institute's founding, it is natural to survey the organization's growth and to assess our effectiveness in reaching out with our message to the larger society. Certainly this is a major concern of charitable foundations when they consider supporting the Institute. It is also a natural concern of our many friends worldwide, which is why we report on our activities in every issue of the newsletter.

Happily, a five-year retrospective gives us ample reason to feel good about how far the Institute has come. We are now offering spring, summer, and fall programs for the public, our publications are reaching ever more people, we find increasing opportunities to connect with other, like-minded groups, and our growing sense is that very many people in today's society are hungry for the kind of reconnection with the natural world that The Nature Institute fosters.

It is true that the idea of a genuinely qualitative science—our central goal—is as yet scarcely a blip on the radar of most conventional scientific institutions. But the forces in society straining toward such a distinctive science are evident on many sides—for example, in ethnobotany and other fields where native wisdom is being respected; in the movement toward organic agriculture; in the tendency to regard the earth as a whole as a kind of living organism; even (as the opening article in this issue suggests) in the employment of textual metaphors to elucidate the genomic aspects of cellular activity.

But if it is important to be able to say we are helping to *change the world*, it is equally important that *we ourselves are being changed*. People who are not adapting and maturing cannot for long bear a worthy message to the rest of the world. Everyone who seeks change must also be willing to be changed.

For example, I (Steve) have been quite struck by how my entire outlook has been enlarged and enriched through exposure to the work of Craig and Henrike, and through collegial exchange within the Institute. And something similar can be said for interaction with readers of *In Context* and our online newsletter, *NetFuture*. When I look back on my earlier writings, I find them a bit one-dimensional by comparison with what now emerges from this cross-fertilization.

Others here report the same experience. All of which makes for a stimulating place to work—and also for a nice balance: we are as grateful for what comes to us from others as many of you seem to be for what you receive from us. This giving and receiving extends all the way from the most abstruse scientific offerings to the most practically grounded financial and volunteer contributions. We hope to continue doing our part to foster the movements in both directions—teaching and learning, giving and receiving.

Craig Holdrege — Steve Talbott

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The Nature Institute

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EDITOR: Steve Talbott
LAYOUT: Mary Giddens

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The Nature Institute
20 May Hill Road
Ghent, New York 12075
Tel.: 518-672-0116
Fax: 518-672-4270
Email: info@natureinstitute.org
Web: www.natureinstitute.org

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Words, Mechanisms, and Life

One of the most striking—and, at first glance, puzzling—features of the contemporary scientific landscape is the juxtaposition of mechanistic thinking with the once-forbidden but now flourishing vocabulary of information, meaning, and design. Why, one wonders, do so many mechanistically minded scientists not only tolerate the use of explanatory concepts relating to mind and language, but positively encourage it?

To see the shape of the problem, it is enough to look at one field—genetics. The drumbeat here has been so insistent that no one can have missed it: the human genome is a *text* composed of nucleotide *letters*; genes are *messages*; DNA is a *script* or a string of *code*; genetics is a science of *information* (leading to the new discipline of bio-informatics); the Human Genome Project has been *deciphering* the *Book of Life*. Consistent with this broad appeal to the language metaphor, molecular biologists routinely employ the terminology of word processing. And so the genomic text is transcribed, edited, spell-checked, translated, copied, read, labeled, indexed, stored in memory, and accessed with information retrieval procedures.

Such terminology is ubiquitous. Two examples will suffice:

> To be fluent in a language, one needs to be able to *read*, to *write*, to *copy*, and to *edit* in that language. The functional equivalents of each of those aspects of fluency have now been embodied in technologies to deal with the language of DNA. (David Jackson, quoted in Kay 2000, p. 1. Emphasis in original.)

> It is the order of [nucleotide] bases along the chain of a DNA molecule that spells out the biological message carried by the DNA, in a four-letter code....This is precisely equivalent to the way the words you are reading convey information spelled out in a 26-letter alphabetic "code". (Gribbin 2000, p. 240)

Precisely equivalent? This is an odd claim to make given that, as science historian Lily Kay has pointed out, DNA is in no sense like any language we know: "it lacks phonemic features, semantics [meaning], punctuation marks and intersymbol restrictions." Analyses of its "letter" frequencies yield only random distributions. Furthermore, "no natural language consists solely of three-letter words," as the genetic code supposedly does. In sum, the genome is "an authorless book of life written in a speechless DNA language" (Kay 2000, p. 2; Kay 1998).

The appeal to technical notions of information does not save all the loose scientific talk. In the first place, the technical theory of information excludes any reference to meaning, so it robs the language metaphor of its entire substance. Citing DNA "messages" that don't mean anything hardly furthers our understanding. And even if the technical theory could somehow help, no one has ever figured out how to map the functioning of DNA to the central concepts of the theory—concepts such as "signal," "noise," "message channel," and so on.

You'd think scientists would insist upon reasonably precise terminology. Yet the misleading and obscure resort to the vocabulary of information, text, and meaning has reached a crescendo during these past few years of the Human Genome Project—this despite the fact that for several decades thoughtful scientists have been pointing out the absurdities in the usage. As a result of the prevailing terminological abuse, the larger public has been convinced that genetic engineers actually know what they're doing when they juggle and splice snippets of genetic "code." After all, the code is being "deciphered," yielding its precise content of "information"—isn't it? And aren't we already experts at information processing, moving bits around in sensible fashion?

Redeeming the Textual View

The confusion about information and genes does not require the geneticist to avoid language about language. The problem arises only from the attempt to assign a word-like character to mere mechanisms. Because these mechanisms, in good Cartesian fashion, are conceived as having nothing meaningful, qualitative, or expressive about them—that is, nothing language-like about them, it is no wonder that explicating them in terms of language lands us in a hopeless muddle. The fault lies, not with the language-based explanation, but with the Cartesian mechanisms.

If, on the one hand, we take language seriously in all its expressive fullness, and if, on the other hand, we take the organism seriously in all *its* expressive fullness, then the necessity of conjoining the two domains becomes obvious. An organism that "expresses" is an organism that in some way "speaks," and when we attend to this expressive speech, it is natural for us to think in terms of words and language. Kay is moving in the same direction when she says, "once the genetic, cellular, organismic, and environmental complexities of DNA's context-dependence are taken into account," we might find that genetic messages "read less like an instruction manual and more like poetry, in all their exquisite polysemy [multiplicity of meaning], ambiguity, and biological nuances" (2000, pp. xviii-xix). Craig Holdrege was getting at the truth of the matter when he wrote:

> We gain a knowledge of genes—as opposed to a mere assertion of their material existence—only through knowledge of the organism as a whole. The more knowledge we have of the organism as a whole, the more information we have. *This information is not in the genes; it is the conceptual thread that weaves together the various details into a meaningful whole.* (Holdrege 1996, p. 80. Emphasis in original)

In other words, it *is* legitimate for the geneticist to liken the organism's functioning to text or speech, but only if the full expressive potentials of both language and organism are acknowledged. Meaningful speech is inseparable from the qualities of things, so that the effort to hear the organism speak must at the same time be an effort to establish a qualitative science. It is through the interpenetrating qualities of the organism's morphological, physiological, developmental, and behavioral gestures that we can read the coherent unity of its "statements."

A primary motive underlying mechanistic science has been the elimination of qualities and meaning. This is why DNA, viewed as a mere mechanism, cannot send messages or otherwise speak in any meaningful sense. All of which raises the question why there is nevertheless such an intense preoccupation with the genetic "text" today.

I believe we can recognize in this preoccupation the fateful collision of two opposing movements. On the one hand, there is an increasing awareness that we cannot grasp the living organism without appealing to the language of life, thought, meaning, and quality. The attempt to restrict science to the traditional, reduced language of mechanism simply no longer satisfies many researchers. This is a positive development that creates a wonderful opening for the practitioners of a qualitative, or Goethean, science.

But, on the other hand, the resort to "text," "information," and all the rest reflects a widespread conviction that now we can reduce and mechanize even the concept of the *word*—which is also to say, even the concept of the concept. It is an impossible goal, and the nonsensical metaphors we noted above are one symptom of the impossibility. But we should not underestimate the negative potential in the current usage. To the extent scientists are willing simply to forget their own capacity for speech and to substitute for it the notion of mechanical interactions, they will not be bothered by nonsense. And meanwhile nothing is to prevent a kind of practical reductionism from taking hold, whereby organisms are treated more and more as mechanisms and therefore come more and more to resemble mechanisms in our understanding and practice.

So there is a grave double potential in the ongoing convergence of the language of mechanism and the language of life. We could see a resuscitation of the dead language of mechanism, so that it is no longer merely mechanistic, or else the final expiration of the language of life, so that it is no longer living.

The language of life, as I indicated, is necessarily a qualitative language. Many of the articles in past issues of *In Context* have aimed to illustrate a scientific approach to the natural world that reckons with qualities. In this current issue, one of the features attempts to look at qualities in a more direct way. *ST*

References

Kay, Lily E. (1998). "A Book of Life? How the Genome Became an Information System and DNA a Language," *Perspectives in Biology and Medicine*, vol. 41, no. 4 (summer), pp. 504-28

Kay, Lily E. (2000). *Who Wrote the Book of Life? A History of the Genetic Code*. Stanford CA: Stanford University Press.

Gribbin, John (2000). *Q is for Quantum: An Encyclopedia of Particle Physics*. New York: Simon and Schuster.

Holdrege, Craig (1996). *Genetics and the Manipulation of Life: The Forgotten Factor of Context*. Hudson NY: Lindisfarne.

Drawing by Martina Müller

The Form of Evolution

Developmental Dynamics in Humans and Other Primates: Discovering Evolutionary Principles through Comparative Morphology, by Jos Verhulst, translation by Catherine Creeger. Ghent NY: Adonis Press, 2003. Hardcover, 413+17 Pages, $39.95.

Jos Verhulst could hardly have startled modern sensitivities more when he wrote:

> Movement toward the human form is present in animal evolution from the outset.... In this sense, the emergence of humanity can be seen as the fulfillment of evolution's longstanding promise. (p. 362)

It is too startling, I suppose, for many to endure. Those evolutionary biologists who do manage to read the book all the way through will, I suspect, be those who realize that Verhulst has abandoned as fruitless the century-old battle between Darwinists and creationists. He is not concerned with organisms as mechanisms or with the question whether the "designer" of these mechanisms is natural selection or God. He appears to believe neither in that sort of design nor in the mechanisms it might produce.

Rather, he brings to his work in comparative morphology an overriding concern for organic form—not just the shape of the individual organism, but the coherent form of the overall evolutionary thrust. He sees this form as essential to an understanding of the dynamic principles of evolution. In other words, he is concerned with form in the older sense of *formal cause*, whereby the particulars of a process are understood through their relations to the larger, expressive pattern of development. That is, they are explained in terms of the observable unity of form, the productive gestalt, of the process as a whole.

So the assessment of Verhulst's thesis—a thesis he presents through a vast array of morphological data—requires only that one observe the relevant forms and note their relationships. This should cause no difficulty for any scientist. Either the relations Verhulst claims to recognize between forms (including the human form) are there to be seen, or they are not. If they are, the implications may be profound—and Verhulst's take on the implications may not be accepted by all readers—but this is no more a reason to reject what one can see with one's own eyes than the profound implications of Galileo's observations were a reason to reject sunspots and the moons of Jupiter.

Beyond Specialization

Verhulst sees two contrary movements at work within evolution. One is the "tendency toward anthropogenesis"—the tendency toward human form. This non-specialized form is not a late-arrival on the evolutionary scene, but is basic to the entire story. And so, regarding the primates, "the human form represents the original primate endowment to a very great extent." *Homo sapiens* is, in a sense, "the most primitive primate."

One of various ways to look at this is through the phenomenon known as "fetalization." For example, the skull of the newborn chimpanzee is remarkably humanlike (see figure on next page), whereas the adult chimpanzee departs strikingly from the human form. Similarly, the hair on a chimpanzee fetus is, in humanlike fashion, restricted to the head, whereas the adult chimpanzee (like all mammals, but not humans) is fully covered with hair. You could say, then, that humans tend to retain certain fetal traits.

Looking at such patterns of development, the anatomist Louis Bolk (1866-1930) asked himself how a humanlike trait that has not previously shown up in evolution could be "prefigured" in a non-human fetus. Clearly it is not a matter of adaptation to outer circumstances in the usual Darwinian sense because, Bolk wrote, "no chimpanzees or their ancestors have ever had naked bodies with hair limited to the head." There was no opportunity for the trait to come under selection pressure.

Bolk therefore suggested that "an intrinsic evolutionary factor must exist, a factor that is already active in principle in anthropoid apes but manifests fully only in humans" (p. 46). Much of Verhulst's book is devoted to the detailed analysis of countless traits pointing in the same direction.

A second evolutionary movement is the tendency toward animal specialization. It is seen, for example, in the brow ridges and extended muzzle of the chimpanzee adult. Likewise, the "hand" and "arm" can specialize into the remarkable capabilities of the salmon's fin, the hawk's wing, the mole's digging limb, the orangutan's arm for swinging, and so on. Such specialization is always a departure from the central, more open-ended pattern, and leads in the direction of a highly tuned adaptation to a particular environmental niche. In this adaptation, Verhulst suggests, there is room for Darwinian natural selection to play a significant role.

In general, "as evolution progresses, the anthropogenetic tendency breaks through to a greater extent and specialization becomes less dramatic. In higher animals, the human gestalt is expressed to a considerable extent, especially during fetal development, until ultimately the anthropogenetic tendency emerges at its strongest in human beings" (p. 95). New traits commonly appear in the juvenile stages of higher animals, but are then overtaken by specializations during the adult stages. But when, in the course of evolution, the juvenile traits persist more and more into later stages of development, childlike qualities manifest in the adult. In this sense you could say that retaining a certain childlikeness is an essential feature of the human being.

Coordinated Development

This is scarcely to gesture toward the richness of Verhulst's book. He is concerned to sketch in great detail the dynamic processes at work in morphological development among primates. These processes include not only fetalization but also retardation, compression, hypermorphosis, and so on. A great virtue of his work is the evident lack of any desire to impose a neat schema upon the data. The complex, interweaving factors affecting development are allowed their unique play in each individual case. This can make for considerable complexity; the book is not always an easy read.

Regarding complexity, Verhulst points to a principle of "synergistic composition" evident in the way numerous movements toward the human form develop in coordinated, mutual dependence. Thus, the juvenile shape of the human skull is inseparable from the enlarged brain and descended larynx. These in turn are connected with the capacity for speech—but this last makes no sense without a more highly developed nervous system as a vehicle for thinking. To make speech possible, the structure of the mouth also had to change, and it had to be freed from its prehensile (grasping) function, which meant that the hands needed to become prehensile, which meant that we needed an upright posture, which demands that almost *everything* changes throughout the organism. Some of these changes helped to free respiration from the constraints of locomotion—a freedom necessary for speech. This same end was served by the development of eccrine sweat glands to form a cooling system no longer dependent on respiration. (You could hardly speak while rapidly panting to cool yourself!)

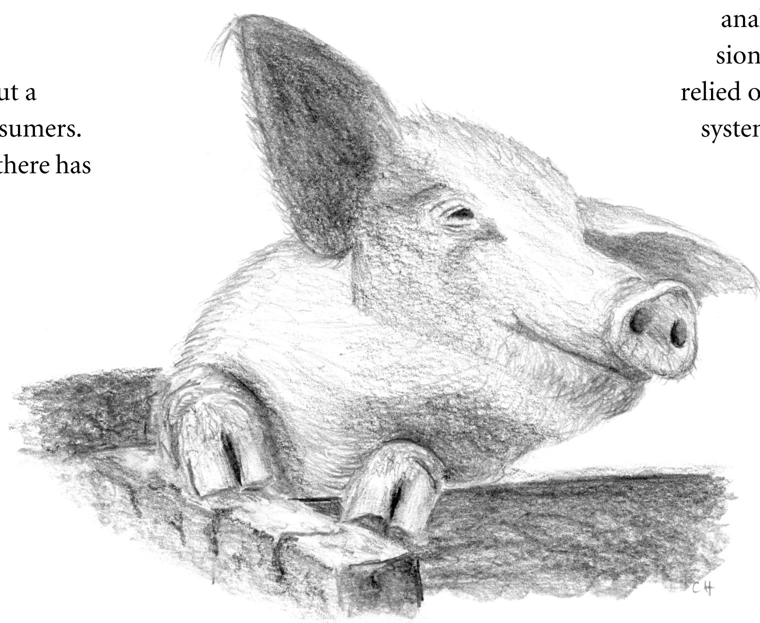
The fact that a single dynamic principle ("retardation," which is closely related to fetalization) is involved in producing all these and many other developments in a unified pattern suggests to Verhulst that the developments were "already prefigured in the prototypic structural plan for the animal body. Because the physical appearance of these effects occurs only at the end of primate evolution, when the retardation has asserted itself fully, they cannot be explained as the result of a physical process of natural selection" (p. 347).

Verhulst sees himself extending an interpretive tradition that goes back to Goethe and Bolk. This reviewer is unable to assess Verhulst's extensive and detailed discussions of morphological features, ranging from fingernails and hair distribution patterns to the position of the larynx. But the attempt by the author of *Developmental Dynamics* to explore new territory beyond the ideological constraints of conventional evolutionary thought and debate could not be more welcome. *ST*

You can order Developmental Dynamics *from Adonis Press, 320 Route 21C, Ghent NY 12075, USA. Tel: 518-672-4736; fax: 518-672-4004.* Email: adonis@taconic.net. Web: adonispress.org. *Adonis Press is directed by John Barnes, a board member of The Nature Institute.*

Assessing a Pig's Life

Heather Thoma



A friend recently showed me an article in the *Ontario Farmer* about a survey of American consumers. The survey found that "there has not been an increase in the number of consumers abandoning pork because of animal welfare concerns"—this despite the fact that most pigs are raised in extremely un-piglike, factory-style environments. The article went on to note that "quality and taste are more important to consumers than the process of meat production."

But perhaps this is because sausage is generally thought of as a food product, not as a breathing, scampering, nosy *pig* whose life led to the ultimate end of being packaged for our breakfast. Things might be different if consumers had a vivid sense of the animal and the actual conditions of its "production and harvesting." But is there any reasonably objective way to assess the quality of the animal's life? Françoise Wemelsfelder thinks there is, and she has devoted several years to developing appropriate methods of assessment.

A student of wildlife biology in the 1980s, Wemelsfelder became interested in research practices using animals. But when she showed concern for experimental animals as "sentient living beings," she was told by her professors that "the capacity of animals to feel and suffer is an assumption that needs testing on objective grounds." Unfortunately, the belief by many scientists that feelings are subjective and non-physical does not leave much room for the idea of objective testing.

Nevertheless, Wemelsfelder wondered whether it was possible to develop a research method that reflected her (and many of her fellow students') way of seeing and relating to animals. This would entail engaging with animals as subjects in their own right, not merely as objects of research to be analyzed part by part. She envisioned a research method that relied on empirical observation in a systematic and scientific way while also allowing animals' feelings to become "formally visible" to human perception.

Learning to Observe

Now working in the Animal Biology Division at Scottish Agricultural College, Penicuick, United Kingdom, Wemelsfelder premises her research upon the conviction that every observer (whether trained or novice) has an ability to offer a meaningful assessment of an animal's behavior. Knowing, however, that careful observation and assessment is an acquired skill that most of us don't practice often enough, her approach—which has resulted in what she calls the Free Choice Profiling method—allows observers to refine their native capacity through practice.

Focusing her work on pigs, she puts a group of observers to work carefully watching a series of pigs interacting one at a time with a person, in a sheltered pen. As the observers watch each pig for seven minutes at a time, they write down the terms which arise as the best descriptors for that pig's behavior. While original versions of the research had observers watching the animals in person, and also watching video recordings of the pigs, the research observations are now simplified by including only observations of video recordings of pigs, since the results were found to be comparable between video and "live" sessions.

The interaction of a naturally inquisitive pig with a human allows the pig to display a range of behaviors that are both individual and relational with the human. The goal of the observer's description is not to describe *what* the animal does (as would be the intent in conventional behavioral research: "it slept for one hour," or "it walked twenty-five feet") but *how* it does what it does. When the pig stands up to burrow into the straw bedding, does it move forcefully? When it pushes on the arm of the human, does it push gently or roughly? And so on.

By observing a range of behaviors from each pig, observers attempt to get an overall sense of the pig's "behavioral style" and each observer freely chooses as many descriptive terms as necessary to give a full picture of each animal. Is a certain pig's action timid, aggressive, nervous, calm?

After observing ten pigs, observers take their lists of descriptors and observe the same pigs on the video again, practicing assessment using the terms they have chosen. This time a line is placed underneath each descriptive term on the recording sheet, and observers make a hash mark to indicate the strength of that quality in the pig under observation. If "aggressive" and "playful" are two terms chosen, then how aggressive and how playful is each pig? A hash mark to the right indicates extreme playfulness, and to the left indicates a slight presence of this quality.

Part of the value of Wemelsfelder's research is that it requires observers to become more aware of their ways of seeing and describing behavior. At the conclusion of each study, after having created and used their own terms to assess pig behavior, the observers are asked to define their chosen terms. They must describe the criteria guiding them in their use of terms during the assessment. "A bold pig is a pig that. . . ."

Bridge-Building

Having participated in a mock round of Wemelsfelder's research myself, I found that the reliance upon the observer's creative role in developing an adequate descriptive vocabulary encouraged a strengthening of my own inner activity while carrying out the work. In conventional research, by contrast, the experimenter chooses the evaluative terms ahead of time. This forces me to move between pre-defined boxes just as the pigs are put into pens and made to move between pre-defined locations. Wemelsfelder's approach is a skill-building approach for the observers and allows for a more authentic, "whole-animal" assessment of the pigs themselves.

Wemelsfelder has found significant agreement between observers' assessments of animal behavior. The work becomes more valid in the eyes of the conventional scientific community because this agreement is confirmed through statistical analysis (using what is called the Generalized Procrustes Method), rather than solely through the experimenter's interpretation of a similarity between the vocabularies chosen by observers to describe the pigs.

My own sense is that by viewing many different pigs and by consciously or unconsciously seeing the different pigs in relation to each other, the observer begins to appreciate the species character running through all the diverse observations. While this appreciation grows out of *interaction*, it can at the same time be a fulfillment of what Goethe calls "the desire to view nature's objects in their own right." It seems to me that Wemelsfelder's method allows observers to develop a capacity for a more objective yet humanly engaged practice of observation.

The development of this research method is an extremely welcome step along the path toward a science where human critical thinking and sensitive observation can be engaged in all aspects of the research, with direct relationship between experimenter, observer, and animal. As we develop more skill in qualitative research such as Wemelsfelder is practicing, we can hope to arrive at a point where statistical results of whatever kind won't be seen as more trustworthy than a researcher's own careful perspective and findings about the animals she studies. In the meantime, it is encouraging to see research such as Wemelsfelder's which builds a sturdy bridge between conventional scientific animal research and newer, rigorous, qualitative methods.

Dr. Wemelsfelder's email address is: f.wemelsfelder@ed.sac.ac.uk

Heather Thoma, who is now farming and teaching in Ontario, was Outreach Coordinator for The Nature Institute until the beginning of 2003.

Bibliography

Goethe, Johann Wolfgang von (1995). *Scientific Studies* (vol. 12 of *Goethe: The Collected Works*). Edited and translated by Douglas Miller. Princeton, NJ: Princeton University Press.

Ontario Farmer (2003). "Survey Shows Consumers Put Meat Quality Ahead of Animal Welfare" (January 14), p. 5.

Wemelsfelder, Françoise (2003). "Seeing Animals Whole." *Resurgence* (January/February), p. 20-21.

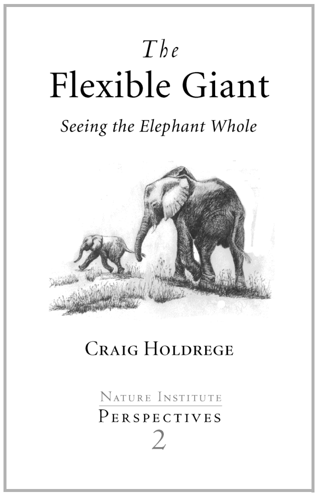
Wemelsfelder, F., T. Hunter, M. Mendl, A. Lawrence (2001). "Assessing the 'Whole Animal': A Free Choice Profiling Approach," *Animal Behaviour*, vol. 62, pp. 209-220.

Wemelsfelder, Françoise (2001). "The Inside and Outside Aspects of Consciousness: Complementary Approaches to the Study of Animal Emotion." *Animal Welfare* vol. 10, pp. 129-139.

On the Road and In Print

Life for The Nature Institute's staff seems to be getting busier and busier. (Need a chance to breathe occasionally!) Here are some of the goings-on:

New Perspective Booklet. The second booklet in our Nature Institute Perspective series is now available. It is Craig's study of the elephant, "The Flexible Giant: Seeing the Elephant Whole." (*In Context* #5 contained an extract from this booklet.) A study of this sort represents the very core of the Institute's work, and we are eager to see it distributed as widely as possible. The 65-page booklet is available from the Institute for $10, and can be ordered using the enclosed form or by contacting us directly.



The first booklet in the series, Steve's *Extraordinary Lives: Disability and Destiny in a Technological Age*, is also available. It has generated many remarkable responses, such as one reviewer's comment, "This inspiring booklet is a gem, a gift to humanity."

Mostly about biotechnology. Craig continues to maintain a busy schedule lecturing and giving workshops. In April, invited by Nature Institute friend and supporter, Ann Kleinschmidt, he traveled to Allegheny College in Pennsylvania. Ann is a molecular biologist and has been using Craig's book on genetics in her courses for a number of years. Craig visited three classes ("Biotechnology," "Genetics," and "Food and Hunger in Society") taught by Ann's colleagues and spoke with the students about different aspects of genetic engineering. He participated in one session of a unique course that Ann and her philosophy colleague, Bill Bywater, teach on Goethean Science. Craig also met with a number of the faculty and spoke to an interdisciplinary class on "The Body in Western Culture." And he gave a public talk, attended by about fifty people, on "The Great Green Hype: Do We Need Genetically Engineered Food." Ann and Bill hope to bring a class to the Institute for a week's study next year.

"Genetically Modified Organisms: The Next Generation" was the topic of Craig's presentation last May at the national Organic Trade Association in Texas. While there, he made contact with many people active in the organic food and agriculture movement.

In July Craig taught the biology students at the New England Waldorf High School Teacher Training course for two weeks in Wilton, New Hampshire. He also gave a talk on "Genetic Engineering and Food" at the Groh Farm in Temple, New Hampshire. This talk was graciously organized by Nature Institute friend, Gerhard Bedding.

Of robots, deceit, and a qualitative science. Steve has been writing intensively for the Institute's online newsletter, *NetFuture*. His essays include a two-part review of *Flesh and Machines: How Robots Will Change Us* by Rodney Brooks, director of MIT's Artificial Intelligence Laboratory. He also wrote, in addition to many shorter pieces, an essay entitled "Intelligence and Its Artifacts," which is an expanded treatment of some of the issues touched on in the article on page 3 of this *In Context*. In the longer piece he wrote:

> So what are we to make of the strange willingness of mechanistic thinkers today (in essential harmony with their creationist opponents) to invoke the terminology of life and mind in their attempt to understand a mechanistically conceived world—terminology that several decades ago would have been decried as vitalist or religious or mystical? Personally, I believe it is a hugely important development, probably marking a great divide in the history of science and civilization. Never again will it be possible to speak about the world except in the language of intelligence, meaning, life, thought. The historical aberration whereby science sought to apprehend the world in non-living terms is coming to an end.

He goes on, however, to point out the dangers inherent in this development: while the *language* of life and meaning is being employed in genetics and elsewhere, the conviction lying behind this use is that our understanding of life itself can be reduced to mechanistic terms.

One of Steve's essays from *NetFuture*, "Toward an Ecological Conversation," will be published in the Fall, 2003 issue of *The New Atlantis*. This is a new and promising journal on technology, policy, and society started about a year ago by the Ethics and Public Policy Center in Washington, D.C. One of the founding editors is a subscriber to *NetFuture*.

Steve is also writing and assembling on the web a collection of papers under the title, "Toward a New, Qualitative Science." (The article on "Qualities" in this issue is extracted from one of these papers.) We expect to announce this subsite of The Nature Institute's website sometime during the spring. All articles from *NetFuture* are available at www.netfuture.org/inx_topical_all.html.

Holistic science. By the time you read this Craig will have given two lectures at a medical doctors' training course in Hadley, Massachusetts, October 11 and 12. The lectures were about "Developing Observation and Thinking Skills Through the Goethean Approach."

On October 17-18, he held a lecture and all-day public workshop on "Genetic Modification: The Sad Misunderstanding of Plants," in Stroud, United Kingdom. It was sponsored by the Biodynamics Association of the U.K.

And from October 20 through 24 he taught three days of a three-week course at Schumacher College in England, "Seeing with new Eyes: An introduction to Holistic Science." He also taught for two days as part of the Master's in Holistic Science program at Schumacher.

Henrike's daytime projective geometry course, begun September 23 and held weekly at the Institute, will run through November 25.

Upcoming. Next winter (February 2-6) Craig and Henrike will teach for a week at the Christian Community seminary in Chicago. Craig will discuss essential features of humans and animals, while Henrike will lead a course on projective geometry.

On February 21 Craig will give a talk at the annual meeting of the Northeast Organic Farmers' Association of Vermont in Richmond, Vermont. He will speak on genetic engineering, agriculture, and food.

Jonathan Talbott and Mike Pewtherer will again conduct wildlife tracking workshops this winter. Please let us know if you are interested.

Reflections on the 2003 Summer Courses

One of the remarkable things about a qualitative, or Goethean, science is the range of interests it appeals to. Our two summer courses, expanded from a single course in 2002, drew several college professors (in philosophy, biology, English); several high school teachers; one kindergarten and one elementary school teacher; three college students; and at least three artists, two writers, and one musician—twenty five participants in all. Each felt that Goethean methods offered something of benefit for his or her own vocation.

One of the week-long courses was introductory and the other intermediate. Both included classes on the methods of Goethean science and practice of plant study. These were supplemented by morning exercises in projective geometry to encourage the development of imaginative thinking, and afternoon practice at drawing from life. Craig taught the science lessons, Henrike the projective geometry, and local artist Martina Müller the drawing. Local woodlands and meadows, along with the nearby wetland overseen by The Nature Institute, provided the natural setting for study.

Here are a few of the comments we received from course participants:

◆ "I recently finished a master's degree in Environmental Science. Many of the courses were static. I wish I could do it over at The Nature Institute; much more dynamic and integrated with larger surroundings. Also met very interesting, sharing people. Enjoyed the entire experience."

Students in the 2003 summer course look more closely at some local grasses.

A student sketching from a vantage point in The Nature Institute's driveway.

◆ "I am very glad to have become acquainted with The Nature Institute and all three of the inspired teachers!... Thank you for creating this wonderful place!"

◆ "This may be the most ideal course I have ever taken. It had a rhythm and balance that was very satisfying. Perhaps you could say it was, in some way, a reflection of nature itself! The combination of studies was very effective. The time for talking was very important too. The atmosphere encouraged risk taking in thinking and speaking—Wow!"

◆ "Learning should be a joyful, fun experience with serious thought and laughter—you folks serve as a wonderful model of how all this can be accomplished!"

◆ "I will teach and write about Goethe's science in an effort to lead others to an alternative way of thinking. It will help me keep my feet on the ground."

◆ "It is such a gentle Aha! experience for me—a peeling away of a veil or film that has covered my eyes for years. It again gives me context and tools for seeing the familiar in a deeper and more penetrating way."

◆ "One of the wonderful gifts of my experience here is the realization it is possible to do one's own research project wherever one lives, and without the necessity to acquire masses of expensive equipment—the realization that the human is the most important instrument."

◆ "This is the beginning of a journey for me, the first step."

We also learned from the (very few!) disappointments expressed by participants, and are resolved always to seek new ways to satisfy the extremely diverse needs and expectations of participants who come from so many different walks of life.

We expect to offer courses again next summer, with announcements coming in February. Feel free to contact us before then if you are interested in attending such a course.

Of Bees and Birds

We reported earlier (*In Context* #8) on a honey bee research project begun at The Nature Institute by Paul Salanki. Currently volunteer James Ferris is carrying on the work with a single research hive of unconventional design. This season he has focused on documenting the bees' preferred sources of pollen throughout the foraging season. Pollen is the sole source of protein for bees, and they carry it in the "pollen baskets" along their hind legs.

Using the Institute's 400x light microscope together with appropriate pollen reference works, James is able to identify, often down to the species level, which plants the pollen is coming from. The bees help through their habit of collecting pollen only from a single species on any given foraging trip—a habit that serves the cross-pollination needs of the plants. Normally the collected pollen is whole and undamaged—and comes in the most fascinating shapes, specific to each type of plant.

This year's study is not yet complete, but the bees' cycle of pollen collection from April into September has already run through the following, diverse range of species: red maple, serviceberry, dandelion, viburnum, apple and pear, red clover, white clover, Japanese rose, purple loosestrife, and goldenrod. As James notes, it is crucial for bees to have forage at all times between April and October, whether the plants are native or introduced, wild or cultivated—or even planted especially for the bees. We are fortunate to be surrounded by a mixed habitat rich in flowering plants throughout the growing season. Thank you, James, for pressing forward with this work!

Nature Institute friend and birdwatcher, Jeanne Bergen, led three "Birds by Ear and Eye" workshops in July. The workshops took place along the Green River in eastern New York, where Jeanne has identified at least seventy-four different bird species. The emphasis was on bird song recognition, and Jeanne provided many tips for identifying songs by various qualities of the notes and melody, pitch pattern, dynamics (intervals between tones, speeding up, slowing down), and so on. The most important factor for recognition, according to Jeanne, is to "penetrate the soul mood" of the song—to perceive its inner qualities. *(continued on p. 23)*

Craig introduces some young visitors to the Institute's elephant skull, housed in our newly finished basement—formerly a garage and root cellar! Our bone collection now has a proper storage facility (mostly in the room behind the door seen here), and we also gain additional classroom/meeting/laboratory space.

Dates with Nature

Upcoming

Friday, November 14, 7:30 p.m. "Speaking Nature's Language." A talk by Gertrude Reif Hughes at The Nature Institute. She is a professor of English and women's studies at Wesleyan University.

Winter, 2003-2004

Tracking workshops at The Nature Institute. Dates to be announced.

January 14: Craig will speak on genetic engineering in Albany, New York. Sponsored by the Regional Farm and Food Project.

February 2-6: Craig and Henrike will teach at the Christian Community seminary in Chicago.

February 21: Northeast Organic Farmers' Association of Vermont, Richmond, Vermont. Craig will speak about genetic engineering, agriculture, and food.

Also look for our spring lecture series and summer courses for 2004

Recent past

September 23–November 25: Tuesday morning projective geometry course at The Nature Institute, taught by Henrike.

October 28: "Goethean Science: How Do We Get There from Here?" a talk by Arthur Zajonc, professor of physics at Amherst College.

October 20-24: Craig teaching at Schumacher College in England.

October 18: "The Nature of Viruses and their Relation to Illness," an all-day workshop by Rodney Richards, Ph.D., and Philip Incao, M.D.

October 17: "Toward a Phenomenology of Illness: Why Are We Susceptible to Infections and Germs?" a talk by Philip Incao, M.D.

October 17-18: "Genetic Modification: The Sad Misunderstanding of Plants," a lecture and workshop by Craig in Stroud, U.K., sponsored by Biodynamics Association of the U.K.

October 11-12: "Developing Observation and Thinking Skills," lectures by Craig to medical doctors, Hadley, Massachusetts.

Ways of Helping

Many of you support our work with an annual gift by becoming a Friend of The Nature Institute. The contributions of this circle of Friends help build a sustainable financial foundation for the Institute. If you haven't yet become a Friend, please consider doing so now. Here are some other ways you can help:

Commemorative gifts

Honor any special occasion—a birthday, marriage, anniversary, or the passing of a loved one—by giving a gift in someone's name to The Nature Institute. The person commemorated and the donor will be acknowledged in *In Context*.

Planned giving

Have you thought of considering The Nature Institute in your estate plans? Your gift can make a lasting contribution. Please contact us.

Matching gifts

If your employer has a matching-gift program, please remember to take advantage of it when making a contribution to The Nature Institute.

Volunteering

We need volunteers for a variety of tasks. We would love to have someone to administer our growing library. At times during the year, helping hands in the garden and grounds would be very welcome. Part of the house and the storage shed need to be painted. And we still need to finish renovating the last room in the basement. Lots of work to be done, as you can see. Maybe there are other services you could offer that might benefit our work. Please let us know if you are interested in volunteering or have a service to offer.

Getting the word out

By telling friends about our work or giving them a publication or a course brochure, you can help us make our efforts more visible and enable us to reach an ever larger group of individuals and organizations. If you'd like extra copies of *In Context* to send to friends or organizations, please let us know.

Achieving the work of The Nature Institute is a collaborative effort. We are proud to be associated with you in this work!

Thank You!

We would like to extend special thanks to the following persons who have contributed money, goods, or services to The Nature Institute (or its online publication, *NetFuture*) between April 2003, and the end of September 2003.

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The Giraffe's Short Neck

Why Evolutionary Thought Needs a Holistic Foundation

Craig Holdrege

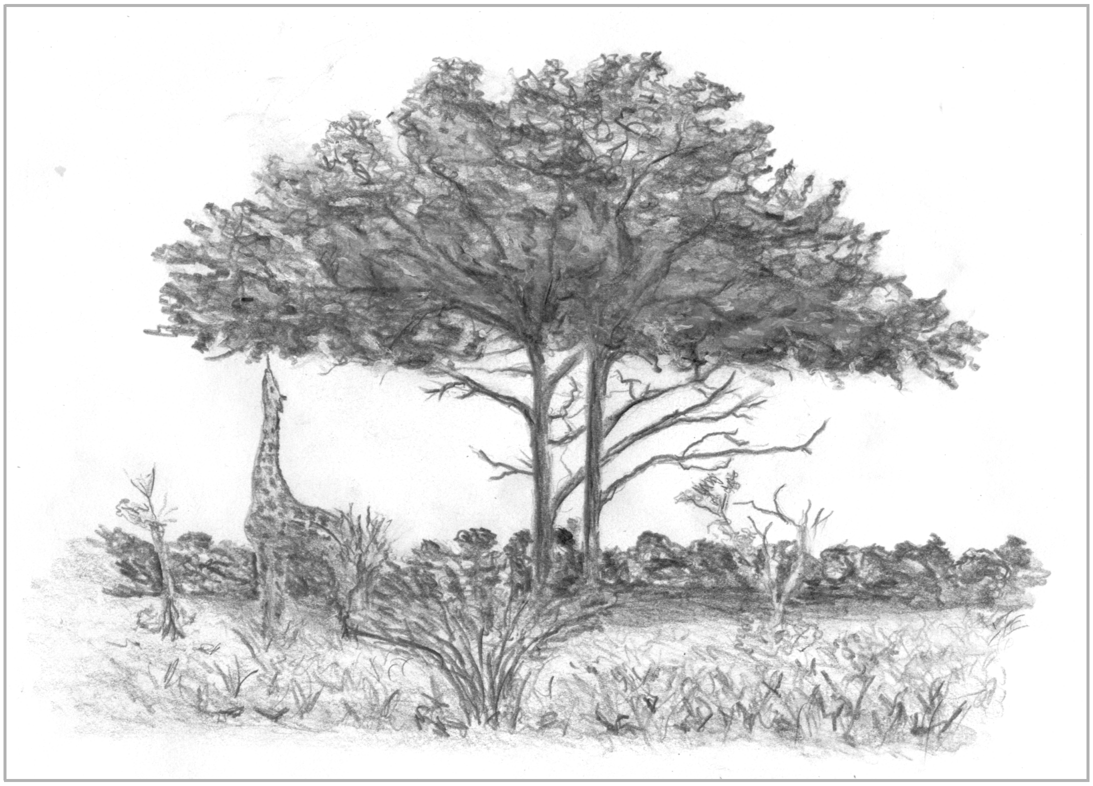

Figure 1. Giraffe in a "classic" feeding position, extending its neck, head, and tongue to reach the leaves of an Acacia tree. (Tsavo National Park, Kenya; drawing by C. Holdrege after a photo in Leuthold and Leuthold 1972.)

This essay is part of a larger monograph on the holistic biology of the giraffe, which will appear later in our Nature Institute Perspectives *series.*

Lamarck and Darwin

Once scientists began thinking about animals in terms of evolution, the giraffe became a welcome—and seemingly straightforward—example. It is as if the giraffe's long neck was begging to be explained by evolutionary theorists.

One of the first evolutionary thinkers, Jean-Baptist Lamarck, offered a short description of how the giraffe evolved in his major work, *Philosophie Zoologique*, which was published in 1809:

> It is interesting to observe the result of habit in the peculiar shape and size of the giraffe: this animal, the tallest of the mammals, is known to live in the interior of Africa in places where the soil is nearly always arid and barren, so that it is obliged to browse on the leaves of trees and to make constant efforts to reach them. From this habit long maintained in all its race, it has resulted that the animal's forelegs have become longer than its hind-legs, and that its neck is lengthened to such a degree that the giraffe, without standing up on its hind-legs, attains a height of six meters. (Quoted in Gould 2002, p. 188)

In Lamarck's view, we must imagine a situation in the past where the best food for browsing mammals was higher up in trees, the lower vegetation having been eaten by other animals. The ancestors of the giraffe—which we should imagine like antelopes or deer—needed to adapt their behavior to this changing environment. As Lamarck wrote, "variations in the environment induce changes in the needs, habits and modes of life of living beings ... these changes give rise to modifications or developments in their organs and the shape of their parts" (p. 179). So Lamarck imagined that over generations the habit of continually reaching for the higher browse produced in the giraffe's ancestors a lengthening of the legs and neck.

A little over sixty years later, Charles Darwin commented on giraffe evolution in the sixth edition (1872) of his seminal book, *Origin of Species*:

> The giraffe, by its lofty stature, much elongated neck, fore-legs, head and tongue, has its whole frame beautifully adapted for browsing on the higher branches of trees. It can thus obtain food beyond the reach of the other Ungulata or hoofed animals inhabiting the same country; and this must be a great advantage to it during dearths.... So under nature with the nascent giraffe the individuals which were the highest browsers, and were able during dearth to reach even an inch or two above the others, will often have been preserved; for they will have roamed over the whole country in search of food.... Those individuals which had some one part or several parts of their bodies rather more elongated than usual, would generally have survived. These will have intercrossed and left offspring, either inheriting the same bodily peculiarities, or with a tendency to vary again in the same manner; whilst the individuals, less favoured in the same respects will have been the most liable to perish.... By this process long-continued, which exactly corresponds with what I have called unconscious selection by man, combined no doubt in a most important manner with the inherited effects of the increased use of parts, it seems to me almost certain that an ordinary hoofed quadruped might be converted into a giraffe. (Darwin 1872, pp. 177ff.)

In many respects this is a classic formulation of how Darwin viewed evolution: every species consists of individuals that show considerable variations. Under certain environmental conditions particular variations will be most advantageous. Natural selection weeds out the unadapted and the best-adapted survive. These variations become dominant in the species and so it evolves. In the case of giraffes, times of drought and arid conditions give an advantage to those animals that can out-compete others by reaching the higher, untouched leaves. They form the ancestral stock of the animals that evolve into giraffes.

Interestingly, Darwin believed in the "inherited effects of the increased use of parts"—a very "Larmarckian" view. Lamarck argued for the inheritance of acquired characteristics. Darwin felt that this was key to explain giraffe evolution; otherwise there is no guarantee that longer features in one generation will have an effect on subsequent ones. But this view of the inheritance of acquired characteristics is rejected by mainstream Darwinists today.

The Long Neck as a Feeding Strategy

The idea that the giraffe got its long neck due to food shortages in the lower reaches of trees seems almost self-evident. The giraffe is taller than all other mammals, can feed where almost no others can, and therefore has a distinct advantage. It seems compelling to say that the long neck and legs developed in relation to this advantage. Why else would the giraffe be so tall? You find this view presented in children's books, in web descriptions of the giraffe, and in textbooks.

But just because this explanation is widespread does not mean it is true. In fact, this "self-evident" explanation retains its ability to convince only as long as we do not get too involved in the actual biological and ecological details. Various scientists have noticed that this elegant picture of giraffe evolution dissolves under closer scrutiny. Here are a few examples of my and their objections:

1) Since the taller, longer-necked, evolving giraffe ancestors were also larger and heavier, they would need more food than the animals they're competing with. Wouldn't this counterbalance their advantage in times of dearth? Would they really have any advantage over smaller members of the same and other species? Moreover, it is absurd to assume that *only* the leaves on high branches were available to the giraffe during a drought. Had this been the case, then the multitude of browsing and grazing antelope species in Africa would all have gone extinct (or never evolved in the first place). So, even without growing taller, the giraffe ancestor could have competed on even terms for those lower leaves.

2) Male giraffes today are up to one meter taller than female giraffes; newborn and young giraffes are much smaller. The moment this sexual dimorphism manifested in the evolution of the giraffe, it would have been the males that could have reached the higher branches. The females and young animals would have died and the species would have gone extinct (Pincher 1949).

3) If giraffes evolved by eating high foliage during times of drought and maximal competition for food, one would expect that giraffes today would also feed from the high foliage during these times in order to avoid competition. Males usually feed at greater heights than females and the results of one study show a surprising spread (Ginnett and Demment 1997). Male giraffes fed nearly half of the time at heights of almost five meters, that is, in the "classical" long-necked giraffe posture. In stark contrast, females fed around seventy percent of the time at belly height or below, which the theory demands they should not be doing. These

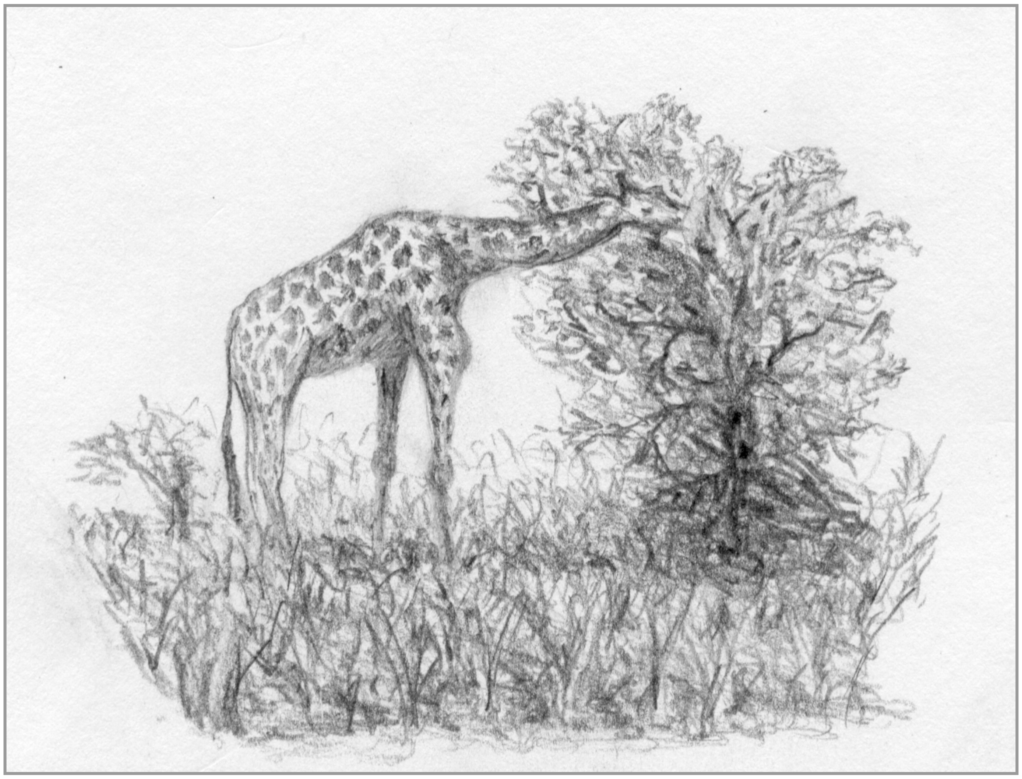

Figure 2. Giraffe feeding at about shoulder height—the most prevalent height at which giraffes feed. (South of Moremi Game Reserve, Botswana; drawing by C. Holdrege.)

researchers did not report on the seasons in which they made these observations, so their results are of little help in discerning whether, for example, males feed at greater heights mainly during droughts.

A variety of other studies show that giraffe feeding habits vary according to place and time (reviewed in Simmons and Scheepers 1996). Giraffes move seasonally, and in the dry season in East Africa they tend to seek out lower valley bottoms and riverine woodlands. There they usually feed from bushes at or below shoulder height (about two and one half meters in females and three meters in males). Fifty percent of the time they fed at a height of two meters or less, which overlaps with the feeding zone of larger herbivores such as the gerenuk and the kudu (Leuthold and Leuthold 1972; Pellew 1984). During the rainy season, when there is abundant browse at all levels, giraffes are more likely to feed from the higher branches, browsing fresh, protein-rich leaves. Other studies also show that giraffes do most of their feeding at about shoulder height, with their necks positioned nearly horizontally (Young and Isbell 1991; Woolnough and du Toit 2001; see Figure 2). So it looks as though giraffes are not using their long necks the way the theory demands. And they use them even less to reach heights in the dry season, when the theory demands they should need them most!

4) There are other ways to reach the high foliage of trees. Goats, for example, are known to climb into trees and eat foliage (see Figure 3). Why didn't tree-climbing leaf-eaters (folivores) develop in the savannah? They would have had the advantage of feeding at all levels easily and been in that respect more adaptable than the highly specialized giraffe. The long-necked gerenuk, an antelope, often stands on its hind limbs and browses, reaching heights of two meters and more. The much larger and heavier elephant even stands sometimes on its back legs and extends its trunk to reach high limbs—but no one thinks that the elephant developed its trunk as a result of selection pressures to reach higher food.

In sum, there is nothing in this theory that shows a compelling link between leg and neck lengthening and feeding on high limbs. Just because giraffes have long necks and long legs and *can* reach food high in the trees does not mean that a need to reach high browse was a causative factor in the evolution of those characteristics.

Clearly, both Darwin's and Lamarck's conceptions of giraffe evolution were highly speculative. The idea that giraffes developed longer legs and necks to reach higher food seems plausible, even compelling, as long as we do not (1) think the idea through in all its implications and (2) take into account essential observations of giraffe behavior and ecology. In the end, the idea is neither logically compelling nor based on fact.

Alternative Explanatory Attempts

Pincher (1949), after critiquing Darwin's explanation, suggests that the "most extraordinary feature of the giraffe is not the length of the neck but the length of the forelegs." By developing long legs, the giraffe has acquired a huge stride so that it can move relatively fast for its size. This has left the giraffe with only one predator—the lion. Pincher therefore explains the "excessive length of its forelegs as the effect of natural selection acting continually through the hunter-hunted relationship, as in the case of hoofed mammals generally." The neck, in turn, followed the lengthening legs so that the giraffe could still reach the ground and drink.

Figure 3. A goat does not require a long neck to feed on twigs and leaves of an oak tree. (Drawing by C. Holdrege after a photo in Butzer 2000.)

It is strange that Pincher is able to critique Darwin's view so clearly and yet doesn't recognize that he is proposing the same type of inadequate explanation. The giraffe ancestor could just as well have developed greater bulk or more running muscles, both of which would have aided in avoiding predators. The fact is that despite its size and long stride, the giraffe is still preyed upon by lions. And as one study of one hundred giraffes killed by lions in South Africa showed, almost twice as many bulls were killed as cows (Pienaar 1969; cited in Simmons and Scheepers 1996). The longer stride of bulls evidently doesn't help them avoid lions better than the shorter legged females. Who knows whether their long stride may in some way make them more vulnerable? Another speculative idea into the wastebasket.

Brownlee (1963) speculates that the lengthening of the limbs and neck in the giraffe give the giraffe a relatively large surface area, which should allow it to dissipate heat. This would be of advantage in the hot tropical climate, so that the tendency toward lengthening would have been encouraged by natural selection, since the largest animals would have been best able to survive heat waves.

As in the other suggested "explanations," the central question is, Is Brownlee's idea rooted in reality? Because of its long legs and neck, the giraffe appears to have a large surface area. But surface area alone is not important; it is the relation of the heat producing volume to surface area that is crucial. A small animal has a small volume in relation to a very large surface area, while a large animal has a very large volume in relation to its relatively small surface area.*Now the giraffe is a very large animal with a barrel-shaped torso. Although its neck is long, it is also voluminous; only the lower parts of the legs, which carry relatively few blood vessels, would act to enlarge the surface-to-volume ratio substantially. Krumbiegel (1971) estimates that the ratio of volume to surface in the giraffe is 11:1, compared, say, to a smaller, long-necked antelope, the gerenuk, which has a ratio of 4.7:1 (similar to the human). In other words, despite appearances, the giraffe still has a very large volume in relation to its surface area and its unique form provides no grounds to think that it evolved in relation to dissipating heat.

More recently, Simmons and Scheepers (1996) proposed that sexual selection has caused the lengthening and enlarging of the neck in males. These scientists place their ideas in relation to known facts and point out shortcomings in rela-

* Assuming for the sake of explanation a spherical body, the two-dimensional surface grows as a function of the square of the radius, while the volume—being three-dimensional—grows as a function of the cube of the radius. A small sphere with a radius of 2.5 cm (1 inch) has a volume-to-surface ratio of 0.8:1. A much larger sphere with a radius of 50 cm (about 20 inches) has a volume-to-surface ration of 16.7:1.

tion to larger contexts—a happy contrast to the other hypotheses we've discussed. They describe how male giraffes fight by clubbing opponents with their large, massive heads; the neck plays the role of a muscular handle. The largest (longest-necked) males are dominant among other male giraffes and mate more frequently. Since long-necked males mate more frequently, selection works in favor of long necks. This would also help explain why males have not only absolutely longer, but proportionately heavier heads than females.

This hypothesis seems consistent with the difference between male and female giraffes. At least it gives a picture of how the longer neck of males can be maintained in evolution. But it doesn't tell us anything about the origin of neck lengthening in giraffes per se—the neck has to reach a length of one or two meters to be used as a weapon for clubbing. How did it get that long in the first place? Moreover, the female giraffe is left out of the explanation, and Simmons and Scheepers can only speculate that female neck lengthening somehow followed that of males. In the end, the authors admit that neck lengthening could have had other causes and that head clubbing is a consequence of a long neck and not a cause.

Does the Giraffe Really Have a Long Neck?

All the above explanations of the evolution of the giraffe's long legs and long neck are unsatisfying. Each of the authors sees problems in other explanations, but remains within the same explanatory framework when putting forward his own hypothesis. No one sees the necessity for stepping outside the framework and looking at the difficulties of the overall approach. The scientists abstract individual features (long neck, long legs, large surface area) and consider them in isolation from the rest of the organism. The individual feature is then placed into relation to *one* purported causal factor in the environment (drought, heat, predator avoidance, male competition). The link of individual feature to environmental factor is supposed to explain the evolution of that feature.

But this is a highly problematic procedure. The giraffe's neck carries out a variety of functions—it allows feeding from high branches, serves as a weapon in males, brings the head to elevated heights that give the giraffe a large field of view, is used as a pendulum while galloping, and so on. Virtually all structures and organs in the animal body are multifunctional and interact dynamically with other multifunctional structures and organs. When scientists pick out a single function and focus solely on it to explain a multifunctional organ, their explanation can only be inadequate. This is comparable to believing you can paint a richly-nuanced, colorful rendition of a landscape with one color. It just does not work.

I sometimes wonder why no one has maintained that the giraffe has, in reality, a *short* neck. If you observe a giraffe

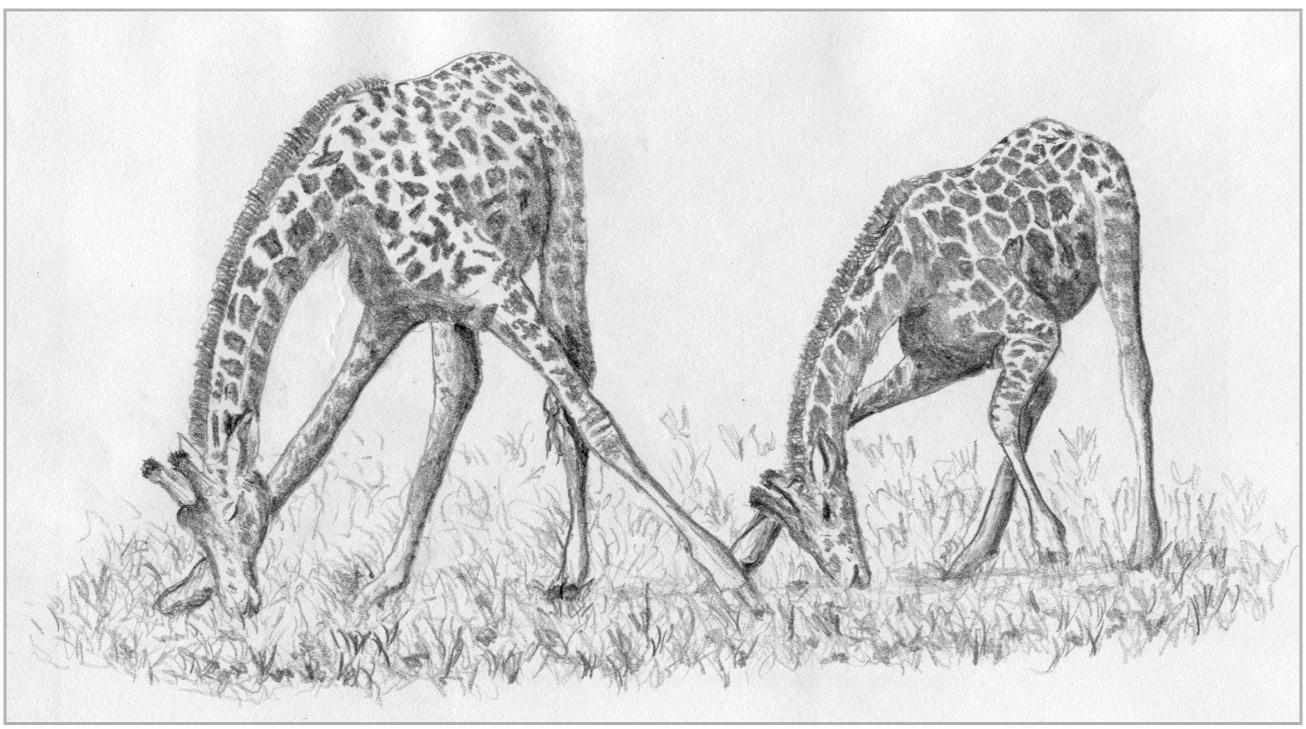

Figure 4. "Short-necked" giraffes grazing. Giraffes can only reach the ground with their mouths to drink or graze by splaying their front legs (left) or splaying and bending their legs (right). (Drawing by C. Holdrege after a photo in Dagg and Foster 1982.)

drinking or, as they occasionally do, grazing close to the ground, then you know what I mean (see Figure 4). Giraffes do not drink often, but when they do, they have to either splay their forelegs to the side or bend their forelegs strongly at the wrist joint. Both procedures take time and are awkward for the giraffe. But only in this way can it get the tip of its mouth down to the surface of the water. So, looked at from the perspective of drinking, the giraffe has a very short neck. Antelopes and zebras reach the ground without bending their legs, and the long-legged elephant has its trunk to compensate for its short neck. Only the giraffe (and its rain forest relative, the Okapi) have necks that are so short relative to their legs and chest that they must splay or bend their legs.

So why hasn't the giraffe become famous for its manifestly short neck? Why don't we have evolutionary hypotheses explaining how the giraffe got its short neck? It is because the giraffe's neck, in other respects or from other perspectives, *is* long. No other mammal has such a long neck in absolute terms or in relation to the length of its torso. We all have seen (in life or in pictures) and been amazed by the standing giraffe, its long neck sailing skyward, in comparison to which the ungainly, short-necked drinking giraffe appears as exceptional, almost unfortunate behavior.

Whether the neck is long or short depends on our perspective and on the behavioral or anatomical context we are focusing on. We only understand the giraffe when we view it from various perspectives and let the giraffe show different aspects of its being. The moment we focus solely on the "long neck"—and on it solely in terms of a food-gathering or some other strategy—we've lost the reality of the giraffe.

Reality is richer than such explanations. The explanation may be coherent and logical, but what it explains is not the thing itself but a specter of it—the isolated aspect that has been abstracted from the whole organism. In reality, the organism as a whole evolves; all its parts are multifunctional, facilitating its interactions with its complex, changing environment. If we don't consider all partial aspects within this larger context, we can only have inadequate explanations void of life.

In sum: the whole project of explaining the evolution of an animal by abstracting from the whole leads to unsatisfying, speculative ideas on the one hand, and to conceptual dissolution of the unity of the organism on the other. A more adequate understanding requires that we first investigate the organism as a whole and how its members interrelate and interact within the context of the whole organism and its environment. This holistic understanding can then form the *starting point* for thinking about the evolution of the animal. The evolutionary biologist Dobzhansky's famous statement that "nothing in biology can be understood except in light of evolution" is a grand claim, which I believe is, in the end, true. But we have a lot of work to do before we get there, and we should not be satisfied with short-cut evolutionary "explanations." Another consequence of the usual way of explaining is that the organism itself is atomized into individual characteristics, each having its own explanation. Each part takes on a quasi-reality of its own, while the whole organism—which brings forth and gives coherence to the parts—degenerates into a kind of epiphenomenon, a mere composite of the surviving parts that "really" count.

If evolutionary thought is to have a solid foundation, we must establish this firm grounding in holistic understanding. As it is, stories of the evolution of traits seem compelling until you look for their context and foundation in the world and discover a pool of quicksand. As Simmons and Scheepers remark about Darwin's idea of giraffe evolution, "it may be no more than a tall story."

References

Brownlee, A. (1963). "Evolution of the Giraffe," *Nature* vol. 200, p. 1022.

Butzer, Karl (2000). "The Human Role in Environmental History," *Nature* vol. 287, pp. 2427-2428.

Dagg, Ann Innis, and J. Bristol Foster (1982). *The Giraffe: Its Biology, Behavior and Ecology.* Malabar FL: Krieger Publishing Company.

Darwin, Charles (1872). *Origin of Species.* Sixth Edition. (Available online at http://pages.britishlibrary.net/charles.darwin/texts/origin_6th/origin6th_07.html)

Ginnett, Tim, and Montague Demment (1997). "Sex Differences in Giraffe Foraging Behavior at Two Spatial Scales," *Oecologia* vol. 110, pp. 291-300.

Gould, Stephan Jay (2002). *The Structure of Evolutionary Theory.* Cambridge, MA: Belknap Press.

Krumbiegel, Ingo (1971). *Die Giraffe.* Wittenberg (Germany): A. Ziemsen Verlag.

Leuthold, Barbara, and Walter Leuthold (1972). "Food Habits of Giraffe in Tsavo National Park, Kenya," *E. Afr. Wildl. J.* vol. 10, pp. 129-141.

Pellew, Robin (1984). "The Feeding Ecology of a Selective Browser, the Giraffe (*Giraffa camelopardalis tippelskirchi*)," *J. Zool., London* vol. 202, pp. 57-81.

Pincher, Chapman (1949). "Evolution of the Giraffe," *Nature* vol. 164, pp. 29-30.

Simmons, Robert, and Lue Scheepers (1996). "Winning by a Neck: Sexual Selection in the Evolution of the Giraffe," *The American Naturalist* vol. 148, pp. 771-786.

Woolnough, A. P., and J.T. du Toit (2001). "Vertical Zonation of Browse Quality in Tree Canopies Exposed to a Size-Structured Guild of African Browsing Ungulates," *Oecologia* vol. 129, pp. 585-590.

Young, Truman, and Lynne Isbell (1991). "Sex Differences in Giraffe Feeding Ecology: Energetic and Social Constraints," *Ethology* vol. 87, pp. 79-89.

Qualities

Steve Talbott

THE CELEBRATED GENETICIST, Barbara McClintock, was well-known—and considered rather eccentric—for cultivating what has been called a "feeling for the organism." A life-long student of corn and its genetic organization, she would observe every plant she studied, starting when it was a tiny seedling. "I don't feel I really know the story if I don't watch the plant all the way along, so I know every plant in the field. I know them intimately, and I find it a great pleasure to know them" (Keller 1983, p. 198).

McClintock's biographer, Evelyn Fox Keller, tells of the geneticist's meeting with a group of graduate and postdoctoral biology students at Harvard University. The students were responsive to her exhortation that they "take the time and look," but they were also troubled. Where does one get the time to look and to think? "They argued that the new technology of molecular biology is self-propelling. It doesn't leave time. There's always the next experiment, the next sequencing to do. The pace of current research seems to preclude such a contemplative stance."

McClintock went on to tell the students how fortunate she had been for having worked with a slow technology, a slow organism. Other researchers disliked corn because you could only grow two crops a year. But she found that even two crops a year were too many. If she was really to observe her plants adequately, one crop was all she could handle.

McClintock had little patience for her many colleagues who were "so intent on making everything numerical," and who therefore missed much of what could be seen. Because of her commitment to the whole, qualitative organism,

> her own method was to "see one kernel [of corn] that was different, and make that understandable." She felt that her colleagues, in their enthusiasm for "counting," too often overlooked that single, aberrant kernel.

Through such oversight, those colleagues sacrificed the potential richness of science. "Things are much more marvelous than the scientific method allows us to conceive" (Keller 1983, pp. 198-207). As for McClintock herself, her "slow" attention to the qualitative nuances of individual corn plants led eventually to discoveries for which she was awarded the Nobel Prize.

A World of Qualities

To pursue a line of thought suggested by the student of language, Owen Barfield: imagine a geologist who, one thousand years from now, uncovers a statue of a human being. Assume further, and quite fantastically, that this geologist has never heard of sculpture. We can, therefore, imagine him contriving various explanations based on geological, hydrological, and meteorological processes to account for the remarkable shape of the statue. But, of course, if he should subsequently learn about sculpture, at least some of his explanations would assume a radically different form.

The difference is instructive, and points us toward what it would mean for science to become qualitative. The key here is not that the geologist would now account for the existence of the work of art by referring to the sculptor's purposes and material activity. Rather, it is that any adequate attempt even to *describe* the statue requires use of a language quite unlike the conventional terminology of science.

Here, for example, are some descriptive phrases applied to statues by the art historian, Ernst Gombrich (1989): "an expression of bold defiance"…. "gesture of lassitude and resignation"…. "air of dignity and repose" …. "expression of pain." Such phrases point to that interior or psychic domain where expressions and gestures arise. An expression, we could say, is an inner movement of consciousness with its own peculiar "shape" or quality. I wave my arm in a threatening way, and you recognize in the contours of the movement a particular inner stance. I wave again, signifying that I was joking, and the inner gesture evident in my arm's motion invites you to enter an altogether different psychic context from the one you were in a moment ago.

Everyone, regardless of philosophical beliefs about psyche, consciousness, or soul, reads the body—and above all the human face—as the expression of an interior that is doing the expressing. When a beloved one smiles, we do not normally occupy ourselves with analyzing the structural features of muscle and bone "explaining" the smile. We explain it with reference to an inner world we share. If we did not do this kind of thing moment by moment, day in and day out, we would find ourselves adrift in society, unable to weave our own meaningful activity into the larger fabric of the world in which we live.

"Hunger," after the drawing by Käthe Kollwitz. By Christina Holdrege.

My arm is part of my physical body, and as such its movement is the external embodiment of an inner expressing. But the human arm itself, apart from its movement and fully as much as the motionless limbs of the statue, is the result of a sculpting—in this case, a sculpting by the complex life process sustaining the physical organism. No less than the statue's arm does this sculpted organ of flesh and bone and blood bear an expressive freight, whether it is the arm of a blacksmith or scribe, queen or scrubwoman, infant or octogenarian. We read something about the inner life, character, and circumstances of the person by observing the gestures "frozen" into the bodily form.

We can say, then, that qualities consist of that inner movement which we might call an "expressing" or "gesturing." The "shape" of the movement, when outwardly embodied, is available for others to read—as a smile or scowl, dismissive wave, come-hither invitation, recoil of surprise, and so on. They achieve this reading by reproducing within their own consciousness the inner movement that is imaged in the outer form.

Two Ways of Looking

Every naturalist is familiar with identification keys. An aid for identifying species, the key typically presents you with a series of yes-or-no questions. For example, in trying to identify a particular tree, you might be led through the following dialogue, where each succeeding question follows a "yes" answer to the previous one:

> Is this a broad-leaved plant with simple rather than compound leaves?
> Are the leaves opposite one another on the branches?
> Is this an erect tree or shrub?
> Are the leaves toothed?
> Are the leaves also lobed?
> Are the twigs neither red nor hairy?
> Are the buds red and blunt with several scales?
> Is the trunk bark rough and not flaking?
> *Then this is a red maple.*

The key, in other words, presents you with a neatly logical framework consisting of a set of crisp, yes-or-no forks in your path of inquiry. Such guides are standard tools for every field naturalist.

Nevertheless, experienced naturalists do not often use a guide of this sort. The recognition they normally rely on in the field is, as zoologist C. F. A. Pantin has pointed out, strikingly different from the laborious, step-by-step logical exercise demanded by the key. "Our recognition of species in the field is commonly instantaneous. We do not consciously traverse a series of dichotomous alternatives, excluding one possibility after another before we arrive at the answer. Indeed it is difficult to believe that we do anything of this sort even unconsciously."

Pantin also notes that the errors committed in what he calls "aesthetic recognition" (and which I will here call "qualitative recognition") differ from the wrong turns we take when traversing a logical key. The latter mistakes are "as disastrous as an arithmetical error in calculation." It is not hard to see why. Taking the wrong fork of a path whose divergences are designed to be clear and unambiguous quite naturally lands you in territory that is clearly and unambiguously the *wrong* territory. Every fork you take after the first wrong turn only confirms your lostness.

An error in qualitative recognition, on the other hand ("For a moment I thought you were your brother") is less clear-cut. In general, Pantin suggests, there is truth in such errors. We were not *altogether* wrong. The mistaken impression was more or less *like* the thing we were really after. "You really do look a little like your brother. In taking you for him, I was genuinely recognizing aspects of him."

This relates to another feature of qualitative recognition, which is that it is not analytical. "It seems to depend on the whole available impression," and this totality is liable to various associative connections. Pantin illustrates this with wonderful examples:

> Even a statement such as "The spines of the sea-urchin I am looking for have something of Chippendale about them—whilst that one looks Hepplewhite" may be significant. And if, when we are collecting *Rhynchodemus bilineatus* together, I say, "Bring me any worms that sneer at you," the probability of your collecting the right species becomes high.

In this case, not only is the probability of correct identification high, but the collection rate will be much faster than when the students are directed to look for the various separate anatomical features that might be analyzed out of the "sneer." Moreover, because the whole impression is an impression of the whole, it does not arbitrarily discard the greater part of what we can recognize in the organism. By contrast, once we have run through our list of yes-or-no features, "a very great deal of the impression which the organism makes upon us still remains 'unused'. This residue is undoubtedly important in our recognition of species even though it cannot be analyzed in just this [yes-or-no] way" (Pantin 1954).

We Cannot Escape Qualities

The idea behind the identification key is straightforward and valuable: break the task down into discrete steps so that each one can routinely and reliably be executed. We arrive at simple, yes-or-no choices by reducing them to the terms of more-or-less unproblematic givens. When, in his famous experiments laying the foundation for modern genetics, Mendel counted violet-flowered and white-flowered peas, he did not puzzle over this or that peculiar shade of violet. Or, if he did, the fact is not reflected in his final tabulation of results.

Similarly, the analytical key aims for judgments that can be automatic and sure-fire: "This is that"—this pea flower is violet, this tree has red buds. But it is crucial to notice that the simple, yes-or-no question does not deliver us from the need to recognize qualities. It merely removes our attention from the recognition. It treats qualities as fixed and obvious, so that we need only count their instances. When we say, "This is that," we increment our count without feeling any need to characterize either this or that.

In slightly different words: the analytical key requires us to recognize qualities without asking questions of them. The demand is, "Have you counted another instance of this quality or not?" rather than "By the way, what *is* this quality? Please describe it." Adequate recognition is simply assumed. This is well and good, since we would be of little use in the world if we were required ceaselessly to contemplate or reexamine every feature we routinely recognize and take for granted.

But if we are interested in science, two considerations become decisive here. One is that we *always* have to do with qualities, whether we are paying attention to the fact or merely counting instances. The other is that paying attention—and doing so by asking questions—is what science is all about. You will recall how Barbara McClintock strove to "see one kernel [of corn] that was different, and make that understandable." By doing so, she was led to the principle of genetic transposition (Keller 1983). This in turn helped to loosen the logical structure of genetics, which had become rigid and brittle. If Mendel's important discoveries had provoked as much interest in the qualities of his violet and white flowers as in his neat arithmetic ratios, we would likely have a far richer and more balanced discipline of genetics today (Holdrege 1996).

As McClintock knew so well, a quality always participates in the whole to which it belongs and is therefore revelatory of the whole. The analytical key collapses this revelatory potential down to a single yes-or-no value, or a group of such values. Such a narrowing of focus and restriction of insight serves many practical purposes. But if this "analytical collapse" of the world remains the sole or primary cognitive movement of the scientist, then the qualitative world begins to disappear and science verges upon a kind of formal emptiness disguised by formidable technique. Qualities alone can fill this void.

The Unity of Cognition

The point needs emphasizing: we can never escape qualities. It is easy to contrast propositional knowledge—the kind of knowledge that comes through analysis and results in sharply articulated, logically well-structured statements of "atomic fact"—with recognitional or qualitative knowledge. The contrast is essential, but even more essential is the understanding that the contrast occurs *within* the unity of cognition. There can be no analytic insight without qualitative recognition, just as there can be no qualitative recognition without analytic insight.

The difference between the two is perhaps more readily experienced than their unity. To use an example given by Ron Brady: you find yourself engaging in one sort of activity when trying to recognize an old friend in a crowd, and quite a different activity when struggling to identify a stranger in the same crowd by proceeding through a list of discrete features (Brady 2002).

You already have an overall impression of your friend—one sufficiently rich in its expressive potential to enable nearly instantaneous recognition of him even in postures or activities you have never witnessed before. As you scan the crowd, there are countless possible gestures of form or movement that might tip you off to the presence of the person you are looking for. Each one of them bears the expressive signature of the same individual. That is, they are all shone through by the same unifying whole—a fact demonstrated by your ability to recognize numerous outward, novel manifestations as nevertheless being those of one individual.

In the analytical approach, by contrast, you are reduced to identifying, one by one, a set of low-level features described in unexpressive and rather more literal terms. Given a set of successful recognitions, you say, "This must be the person"—but you still do not *recognize* him in the way you would a friend. Time and familiarity are required before you can experience the inner, expressive unity that raises the particulars into a coherent and multi-dimensioned whole.

Yet, despite these differences, we cannot consider the two strategies of cognition apart from each other. You cannot, after all, proceed through your analytical key—your list of discrete features relating to a single individual—without first being able to recognize human beings as distinct from, say, trees or rocks. Then, too, each of the features you are looking for—a long, straight nose, curly brown hair, a prominent wrinkle—while analyzed out of a larger whole, in turn expresses its own unity and must be recognized as such a unified expression. If you needed to learn to identify a nose (and all the other particular features) with the help of yet another analytical key, then your search would be hopelessly slow. And, even then, the effort to identify a nose would depend upon yet further "givens" that you would have to recognize.

The aim of the analytic approach is to make the necessary recognitions so simple and unproblematic that they are absolutely reliable, or nearly so. It is, of course, always necessary to strive toward reliability, and analytic methods are important to this striving. But any one-sided resort to these methods is itself highly problematic, for two reasons: first, it encourages reliance upon habit—upon recognitions so routine that we need no longer question or deepen them; and second, because it beguiles us into the belief that real knowledge is of a simple, yes-or-no sort, and that we do not have to deal with the qualities of things. Since this ignoring of qualities is an impossible ideal to achieve, we end up relying on qualities that we have unconsciously projected into the phenomena we are studying, as when we think of subatomic "particles" as solid little balls.

(The preceding is extracted from a very much longer paper that will become available next spring. While these extracts focus upon the qualities of living organisms, the point of the larger paper is that the world in general is compacted of qualities. It is an expressive world.)

References

Brady, R. H. (2002). "Perception: Connections Between Art and Science." Available at http://www.netfuture.org/ni/misc/pub/brady/art/perception.html.

Gombrich, E. H. (1989). *The Story of Art*. Oxford: Phaidon.

Holdrege, Craig (1996). *Genetics and the Manipulation of Life: The Forgotten Factor of Context*. Hudson, New York: Lindisfarne.

Keller, Evelyn Fox (1983). *A Feeling for the Organism: The Life and Work of Barbara McClintock*. New York: W. H. Freeman.

Pantin, C. F. A. (1954). "The Recognition of Species," *Science Progress* vol. 42, pp. 587-98.

Of Bees and Birds *(continued from page 11)*

Jeanne, who ran these workshops as a benefit for The Nature Institute, has invested a tremendous amount of labor in mowing and maintaining pathways through parts of the several-hundred-acre tract along the Green River.

A substantial chunk of this tract is now on the market, raising fears that it may be lost as a wildlife sanctuary—this despite the fact that, as Jeanne notes, "It's a flood plain, not suitable for anything but sanctuary." Foxes, bears, coyotes, and many other forms of wildlife make the land much more than a bird refuge.

If you have ideas for the future of this land, please call Jeanne at 518-325-5806.

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