



In Context

The Newsletter of **The Nature Institute**

Letter to Our Readers 2

NOTES AND REVIEWS

Two Questions / *Stephen L. Talbott* 3

NEWS FROM THE INSTITUTE

Reflections on a Watery Residency 5

Events 6

Publications and Website 7

2020 Winter Intensive 8

From Our Mailbox 10

Board and Staff Changes 10

A New Challenge Grant! 10

Thank You! 11

FEATURE ARTICLE

The Intertwined Worlds of Zebra and Lion

Craig Holdrege 12



#43

Spring 2020



The Nature Institute

Dear Friends,

As we write you this letter in early April, we are in the midst of the Covid-19 pandemic. From The Nature Institute we send our good thoughts your way—for you, your families, friends, and colleagues.

This pandemic, and the global response to it, brings humanity into a wholly new situation. Thousands of people have passed away and many more thousands have fallen ill. Virtually all people on the earth are isolating and having to learn to lead a different kind of daily life. As people buy fewer goods and partake in fewer services, millions of workers lose their jobs. Humanity faces an uncertain future as much of the consume-driven world economy disintegrates. Who knows where things will stand when you receive this issue of *In Context*?

Looking to non-human nature during this time, we can, for example, see how air pollution coming from cities has lessened, and the sky is disburdened of immense airplane traffic. There is a quiet in nature that contrasts so starkly with all the concerns we human beings carry in our souls.

The contrast between our human-created world, with all its complexities and uncertainties, and the other-than-human natural world seems especially vivid at this time. On my daily morning walks I have been observing how the buds of trees are beginning to open—first the aspens, then the red maples; the oaks and hickories still waiting. On the grounds of the Institute, crocuses have emerged from the soil, bringing color, gestural form, and food for insects into the early spring. There is a wisdom in this connectedness of nature's creations with the larger rhythm of seasons.

But it is not easy in these times to engage the inner activity needed to counteract fear and uncertainty. How often we hear each other remark on how unsettling, strange, and challenging things are! We are in one way thrown back on ourselves. We are not carried by our usual rhythms and routines. We hear from others and experience ourselves how challenging it can be to bring about self-willed activity. And we also think of the many teachers who are trying to help their home-bound students find meaningful activities. With all this in mind, we decided to make Henrike's workbook on projective geometry, *To the Infinite and Back Again*, freely available on our website. It gives the reader the opportunity to bring thinking into a focused activity that lives in transformations. We are surprised and heartened by the many expressions of gratitude we have received.

Attunement with the large and wise living forces of the world is what we as human beings sorely lack and just as sorely need if we want to contribute to societal and ecological healing. Rocks, plants, and animals are attuned; they exist embedded in the larger wisdom of the world. We in a sense stand apart. We can question our place in existence and can freely use our minds to inquire and create. What we create—whether destructive or furthering to the life of our fellow beings and the earth—depends on where we place our attention and what from the world provides orientation for our thinking and acting.

At the Institute we are always striving to let life itself be our teacher. We find strength in this endeavor and hope that the fruits of our work as they appear in *In Context* are worthwhile for you.

Warm greetings,

Craig Holdrege

Steve Talbott

STAFF

Craig Holdrege
Henrike Holdrege
Elaine Khosrova
Kristy King
Judith Madey
Veronica Madey
Stephen L. Talbott
Gopi Krishna Vijaya

ADJUNCT RESEARCHERS/FACULTY

Bruno Follador
Jon McAlice
Marisha Plotnik
Vladislav Rozentuller
Sergio Spalter
Nathaniel Williams
Johannes Wirz

BOARD OF DIRECTORS

Siral Crane
Craig Holdrege
Henrike Holdrege
Marisha Plotnik
Jan Kees Saltet
Signe Schaefer
Jeffrey Sexton
Nathaniel Williams

BOARD OF ADVISORS

Will Brinton
Gertrude Reif Hughes
Wes Jackson
Andrew Kimbrell
Fred Kirschenmann
Johannes Kühl
George Russell
Langdon Winner
Arthur Zajonc

In Context

Copyright 2020 The Nature Institute.

EDITOR: Stephen L. Talbott

LAYOUT: Mary Giddens

COVER ART: Kristelle Esterhuizen

Copies of *In Context* are free while the supply lasts. All issues are posted on the Institute website.

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

The Nature Institute, Inc., is a non-profit organization recognized as tax-exempt by the IRS under section 501(c)(3).

Two Questions

STEPHEN L. TALBOTT

Following are the introductions to two chapters of Steve's book-in-progress called "Evolution As It Was Meant To Be — and the Living Narratives That Tell Its Story." These brief introductions are intended simply to pose the questions that the chapters then discuss. The full text of these two chapters, along with all the others currently written, will be freely available at natureinstitute.org/txt/st/bk/. Note: the full titles of the actual chapters are "All Science Must be Rooted in Experience" and "Why We Cannot Explain the Form of Organisms." This second article may have morphed into two articles by the time it is posted to the website.

Is Science Experiential?

In previous chapters we have seen how organisms, as centered agents, present us with rich, narrative contexts — mortal performances that proceed, with characteristic expressiveness and intention, through the stages of a life drama unique to their own species. And yet, as we have also seen, a powerful urge drives biologists to ignore, as far as they can, every distinctively living feature of those performances.

They ignore, for example, what it must really *mean* when they say that animals "strive" to maintain their life, or that a wound "heals" itself, or that an organism "adapts" to its environment, or that it "perceives" a threat and "responds" to it. (Stones do not strive, heal, adapt, perceive, or respond.) But it is all too easy for any scientist to sidestep such meanings and analyze the organism's story into lifeless sequences of precisely lawful molecular interactions. And since there appear to be no gaps in the molecular-level picture, the resulting explanations seem complete. Only the organism is missing.

In other words, seamless as they may be in their own impoverished terms, such explanations are not in fact complete. They miss the simply observed fact that molecular-level interactions in an organism are always caught up in the higher-level pattern of one or another life story. We always find ourselves watching the meaningful *coordination of causal processes in an extended narrative*

— a coordination that cannot be explained by the causal processes being coordinated. This is why explanations that never move beyond physics and chemistry stop short of biology.

Non-living explanations do, however, have one advantage: they conveniently avoid all those troublesome words I use throughout this book in discussing organic contexts and life stories — words such as *intention* and *purposiveness*, *idea* and *thought*, *agency* and *end-directedness*, *interests* and *meaning*. Most biologists prefer to have nothing to do with such terms.

One problem with those words is that they evoke features of our own inner lives — our human *experience*. It is, of course, healthy to avoid an anthropomorphic projection of human experience upon other organisms, where it does not belong. But we, too, are organisms, and we have good reason to ask: Where *does* living human awareness belong in our biological science? If we ignore the character of our own life and experience, can we fully understand a world that has been capable of producing *us*? Where can we gain our scientific ideas, if they are not *empirical* — if they are not expressions of our most rigorously considered *human experience*? And can we reasonably assume that our own experience has nothing at all in common with that of our evolutionary forebears?

Can We Explain Organic Form?

The problem of form has long been central to biology, where each creature so notably reproduces after its own kind and according to its own form. "It is hardly too much to say," wrote geneticist C. H. Waddington, "that the whole science of biology has its origin in the study of form." Through both their descriptive and theoretical activity, biologists "have been immersed in a lore of form and spatial configuration."

And yet questions of form have seemed oddly resistant to the biologist's quest for explanation. Darwin himself seemed to sense a special challenge in that famous instance where



Mallard duck showing bright blue speculum.



A speculum feather from a mallard duck.

he recoiled from contemplating the subtle perfections in the form of the eye: “To suppose that the eye with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest degree.”

Of course, as Darwin quickly added, his theory convinced him that he was merely suffering from a lack of imagination. All that was really needed were the creative powers of natural selection acting through eons upon an endless supply of small, helpful changes. But his underlying malaise was not so easily vanquished: “It is curious,” he wrote to the American botanist Asa Gray in the year following publication of the *Origin*, “that I remember well [the] time when the thought of the eye made me cold all over, but I have got over this stage of the complaint, and now small trifling particulars of structure often make me very uncomfortable. The sight of a feather in a peacock’s tail, whenever I gaze at it, makes me sick!”

We can assume that Darwin got over that stage of the complaint as well. But, thankfully, the biologist is still now and then allowed, if not a complaint, at least an honest expression of wonder. The great twentieth-century student of animal form, Adolf Portmann, writing not of the peacock, but of another bird with a remarkable pattern of coloration on its wings, helps us to share in his own wonder:

If ... we look at the speculum on a duck’s wing, we might imagine that an artist had drawn his brush across some ten blank feathers, which overlap sideways — making white, bluey-green, and black lines — so that the stroke of the brush touched only the exposed part of each feather. The pattern is a single whole, superimposed on the individual feathers, so that the design on each, seen by itself, no longer appears

symmetrical. We realize the astonishing nature of such a combined pattern only when we consider that it develops inside several or many feather sheaths completely separated from one another; and that in each individual feather it appears at an early stage while it is still tightly rolled up, the join pattern not being produced until these feathers are unfolded. What sort of unknown forces direct the construction work in the ‘painting’ of these feather germs?

Whatever Portmann’s “unknown forces” may be, they seem to work to perfection. But how are we to understand this perfection? What sort of explanation are we looking for when we want to make *sense* of form? In the case of that patch of color on the duck’s wings, surely we will eventually be able to trace exhaustively the processes and connections by which the molecules of pigment come to be present at the proper places in the various feathers. But where, amid the innumerable, widely dispersed molecular jiggings, transits, collisions, interactions, and transformations, will we glimpse the global coordinating power that guarantees the final, aesthetically satisfying outcome in the face of all the degrees of freedom possessed by the interacting molecules?



Eyespot on a peacock feather.

Reflections on a Watery Residency

LAURA RUBIANO-GOMEZ

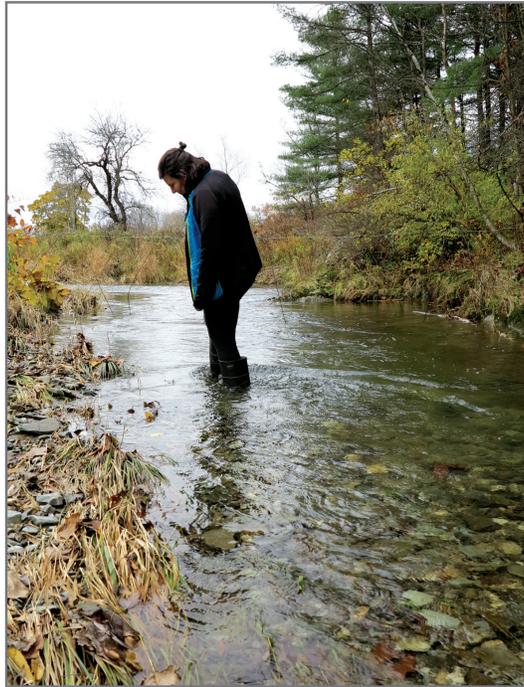
Continuing its substantive role as an incubator for post-graduate work in Goethean methods, the Institute welcomed oceanographer and Waldorf teacher Laura Rubiano-Gomez to a residency in late 2019. She spent nine weeks with us, investigating water phenomena to inform her goal of creating a more holistic, active, high school curriculum for hydrology. Here Laura writes revealingly about the experience:

“You cannot step twice into the same river.” – Heraclitus

The time I spent at The Nature Institute last fall afforded me the opportunity to experience water phenomena in a new and deeper way. In order to really understand how my engagement with water has shifted, I need to take a step back. It would not be a stretch to say that I have had a life-long fascination with water, and it came as no surprise to anyone when I decided to study environmental engineering and oceanography in college and graduate school. However, it might come as a surprise to those reading this, if I were to tell you that I had very few opportunities to observe water as part of my formal education.

During my junior year in college I took a class called “Transport Processes in the Environment.” The focus of this class was to understand the movement of water in river and lake systems, and by extension the fate and transport of dissolved pollutants. The class was coupled with a practical lab which served to highlight concepts already discussed during lectures, but at no point did we actually observe the flow of water in a river or lake. The closest we got was a group exercise where we were asked to devise a method to determine the flow of the Charles River in Cambridge, Massachusetts.

In graduate school I worked on a computer model that would simulate the water circulation in the Gulf of Maine, but at no point was I required, nor was it suggested, to “experience” the Gulf of Maine. I quickly realized computer modeling was not for me, and tried to get myself on as many research cruises as I could. Oceanographic cruises often involve being at sea for days and weeks at a time, and



while the focus is the collection of data via highly specialized instruments, at least you are out in the environment you are studying. It is important to note that one can receive a degree in oceanography or environmental engineering without ever setting foot in the field, without experiencing directly your subject of study.

It was probably during one of the many oceanographic cruises I participated in that I started to not just focus on the data collection aspect, but also on observing the water around me. If you are out far enough, there is a lot of water to observe, and by paying attention you are rewarded with unique experiences. Since then, I have

continued to devote care and attention to observing water wherever I go.

The intention for my time at The Nature Institute was to work on a phenomenological high school hydrology curriculum. My previous experiences teaching this topic have left me wanting to find a different and deeper way for the students to connect to water phenomena, and this became the driving force for basing the curriculum on phenomenology. In order to stay strictly with the phenomena, I started doing almost daily observations of the Agawamuck Creek, just a short walk from The Nature Institute.

As I started to organize and write down my thoughts, I realized I was bringing into my thinking and writing too many already-formed concepts. I was in the realm of abstraction instead of staying with the phenomena. At this point I went back to observing the creek. During this process it dawned on me that I had been approaching the creek with an agenda. I was looking for the conditions I already knew affected the flow of the creek, such as places where the creek bed narrowed

or became more shallow, and I also focused on areas where I expected the water to flow upstream. I had a list of concepts I wanted to include in my curriculum, and was actively seeking them out at the creek to the exclusion of everything else. The result was a feeling that I was imposing my expectations on the creek, and an inability to see anything new.

After this realization I chose a different way of relating to the creek. I would arrive each morning, and simply be. No agenda, no preconceived ideas about what I was seeing just an openness to reconnect. I walked along the banks or waded in and waited for something to catch my interest and then delve deeper. This new approach was key in helping me see aspects of water phenomena I might have seen before, but never paid attention to consciously.

One new aspect of water I noticed was the interaction between the water and the creek bed. I started to focus on places where the flow of water was being obstructed, whether by a rock, a log, or a twig. I observed how the movement of the water changed upstream and downstream of the obstruction, and paid attention to how this movement changed on days the creek flow was especially high. I was mesmerized by how the sediment around a rock was suspended, moved downstream and redeposited, and how this process changed depending on the size of the obstruction and the strength of the flow.

I was awestruck by an accumulation of leaves, acorns, and twigs on the creek-bed that formed a patch in a particular section of the creek. Every day I came back to observe this particular area, and noticed something new. One day it would be the fact that the debris patch had increased in size. On another, it would be the formation of sediment ripples. I noticed that the directionality of the sediment ripples mimicked the rippling surface of the water. The movement of the water was being mirrored on the creek-bed, bringing together the constantly changing quality of water into the coalescing form of the sediment ripple.

Through my observations of water, my inner state seemed to have taken on the ever-changing and flexible aspects of water. This shift in being with the creek, along with continued study of texts relating to Goethean Science, have been invaluable aspects of the time I have spent at The Nature Institute. As a science teacher working on teaching through phenomenology, it is important for me to have the time and space to practice observation and to deconstruct my own thinking – to be able to pinpoint when I am directly working with the phenomena, and when I am working with already-formed abstractions of the phenomena. It has also been important for me to further my understanding of the philosophical underpinnings of phenomenology in order to improve the way I teach and communicate about my work.

Events

- Craig and Henrike returned to **Florianopolis, Brazil** in November to complete the second two-week module of a four-week course on “Seeing Nature Whole: Foundations of Goethean Science.” They plan to start a new four-week course there in April 2021.



Observing shadow movement during Brazil course.

- In January, Craig traveled to **Melbourne, Australia**, to give a series of keynote talks on “From Encounter to Insights: Pathways of Experience in Education” at a week-long professional development conference for Waldorf high school teachers. He also taught a course for biology teachers and one on “Delicate Empiricism: Practicing Goethean Inquiry.” After the conference he led a public workshop in Melbourne on “Finding Our Humanity: Freedom and Our Responsibility for the Earth.”
- Henrike and Craig taught six sessions in January and February for students in the teacher training program of the local **Alkion Center**. Participants engaged in projective geometry and explored animal and human form and how it can reveal our own deeper nature and that of our fellow creatures.
- In March, Craig gave a half-day workshop in Spring Valley, New York, on “Seeing Nature Whole” at the **Pfeifer Center’s** one-year training course in biodynamic agriculture.
- Our Winter Intensive in 2020 ran for five days in February, during which we guided participants in practical exercises, observations, and discovery to help them experience nature as dynamic, interconnected, and whole. See photos and comments from the work on pages 8–9.

As of this writing, our scheduled summer courses are unconfirmed as we await coronavirus trends. As the next weeks progress, we will follow projections for this uncharted phenomenon and query participants as we try to arrive at a decision.

- In July, more than 20 participants are scheduled to arrive at The Nature Institute to begin their **Foundation Year of Goethean Science**, *Encountering Nature and the Nature of Things*. In this low-residency program — now in its third year — those enrolled meet at our campus for an intensive two-week experience in “living thinking” and phenomenological practice. This introduction is then followed by eleven months of mentored, independent work and online forums with staff of the Institute. Finally, an on-site, two-week intensive next summer will complete their course. Applicants to this year’s program come from Canada, Australia, The United Kingdom, Brazil, India, and South Africa, as well as eight different states. Many are teachers themselves, but this third running of our program has also attracted a filmmaker, artist, organizational development consultant, biologist, art studio facilitator, conservationist, and several biodynamic farmers.

We also have a cohort of students who came to the Institute last summer for the 2019-2020 Foundation program and hope to complete their training at the end of June.

- The staff of The Nature Institute will be collaborating with **two new, experience-based and contemplative education initiatives**, beginning this September. Locally, at the M. C. Richards Program being launched by Free Columbia (freecolumbia.org), Craig will lead courses in experiential learning in biology and phenomenology. Henrike will teach projective geometry as an exercise in cognitive clarity, and also a course on visual experience, color, light, and darkness. And Gopi will address “Model-free Physics and the Forces of Technology” — all this along with contributions from other faculty. Then, at the Thoreau College Semester Program (thoreaucollege.org) in Wisconsin, Craig and Henrike will each lead a week-long intensive.

Now Freely Available !

Henrike’s well-received workbook on projective geometry, *To the Infinite and Back Again*, Part 1, is now freely downloadable from our website: http://natureinstitute.org/txt/hh/bk/pg_pt1.pdf. We hope that, along with many others who have written to us of their appreciation, you will find your work in this book to be a welcome relief from the stresses of our current social conditions.

Publications and Website

In May 2019, Craig and Henrike guided a colloquium of the Research Institute for Waldorf Education on the topic, “**When Nature Becomes a Presence.**” As background reading for the colloquium they chose two articles, which, along with an introduction by Craig, were published in the Fall/Winter 2019 volume of the Institute’s *Research Bulletin*. These articles are now available online at waldorflibrary.org (search under the author name). We highly recommend these stimulating articles:

- “Grounding Through Sense Experience: Preface to Articles by Rudolf Steiner and Albert Borgmann,” by Craig Holdrege
- “A Path to the Reality of the Sense World,” by Rudolf Steiner
- “The Nature of Reality and the Reality of Nature,” by Albert Borgmann

Craig’s article “Encounter-Based Science: From Learning About to Learning Through” will appear in the spring/summer 2020 issue of *Renewal magazine*.

Continuing his research and development of a book-length project, *Evolution At It Was Meant To Be – and the Living Narratives That Tell Its Story*, Stephen Talbott has placed a steadily growing number of chapters onto the Nature Institute website. (See the Notes and Reviews section of this issue for the brief introductory sections of two of the more recently posted chapters.) The book reframes our understanding of organisms (with special emphasis on the molecular level) in terms usually forbidden to biologists — terms such as “agency,” “purposiveness,” “intention,” and “meaning.” One aim of the book is to clarify the uses and misuses of such terms, and to show the dramatic implications for evolutionary theory once we are willing to acknowledge, for example, the agency of organisms. All chapters are freely available on our website: natureinstitute.org/txt/st/bk/. Steve welcomes peer review and comments from readers.

In the fall 2020, Lindisfarne Books will publish Craig Holdrege’s *Seeing the Animal Whole: And Why It Matters*. The book is the culmination of Craig’s popular whole-organism studies that reveal how intimately and distinctly each animal intersects with the earthly context that supports its life.

After much discussion internally and with consultants, we’ve embarked on the process of **remodeling our website** to bring it up to current design standards. The project will be a lengthy one, since natureinstitute.org holds more than 20 years’ research and teaching content in 700-plus pages! The main results of the design work will not be publicly visible until the completion of the project. Stay tuned ...

2020 Winter Intensive

In February, we welcomed a new and diverse group of participants to our annual Winter Intensive to explore the theme of *The Living Earth*. Together we engaged in practical exercises and careful indoor and outdoor observations of plants, water, warmth, air, and earth. While examining the myriad, detailed qualities of each phenomenon, we also worked to grasp its dynamic wholeness. Reflecting on the practice afterwards, participants shared their thoughts:



Our group experimented, individually and collectively, with the dynamic movement of fluids and the character of water drops.

“I loved the experiments! I loved moving through exercises of direct observation. The concept of “phenomena illuminating phenomena” rang true. The days were broken up really well with breaks and opportunities to clear one’s head. The facilities are stunning! The space feels loved and cared for and honored which is so conducive to the work.”





"I have naturally been drawn to observation. However, in my schooling memorization was preferred. This course has ... given me some context, a basis to acknowledge that my natural tendencies were not wrong. Wanting to know via observation is relevant."



"I very much enjoyed the close observations of the plants and flowers, really exemplifying to us what "careful attention" is. In the end, it is clear to see how the elements, plants, philosophy, and nature all weave together to create a much larger, more whole image."

Outdoors we observed skunk cabbage, the growth form of trees in forests, and bored holes of pileated woodpeckers. We also carried out an experiment in which we heated twigs from a tree in an iron tube without letting in any fresh air; here (right) we are "capturing" water vapor and other vapors. After the heating, the wood in the tube had become carbon while retaining all details of its form.



From Our Mailbox

From Australia, one of our readers writes:

... I wish to express my deep gratitude for your website and all the free materials that you have allowed people to access. I have been going through them as well as your book, *Thinking Like A Plant*, and find them to be some of the most practical, relatable writings on the subject.... An amazing body of work and one that is of increasing importance.



Last fall, Jonatha Giddens, Chief Scientist with the National Geographic Society Deep-Sea Research Project, asked for Craig's advice on bringing a Goethean scientific approach to her colleagues for an upcoming Galapagos expedition. Craig made several suggestions for practical exercises to generate qualitative, rather than the usual quantitative, observations. In December, she wrote back:

The expedition went really well! The science team was very open and excited to participate in the observation, drawing, and writing activities I had prepared for us. I especially loved working with haikus. I'm looking forward to sharing this art-integrated approach more within the Nat Geo community of Explorers."

To read Jonatha's in-depth article about orienting her expedition colleagues to new observation techniques, go to the online magazine *Verde Galapagos* (fidal-amlat.org/verde-galapagos) and click on the December 2019 issue.

Board and Staff Changes

This past fall **John Barnes** stepped back from The Nature Institute's Board of Directors. John was a founding board member and served selflessly for 21 years! In the year before the Institute was founded, John was instrumental working with us to articulate the basic ideals and goals of the Institute. We value the quiet wisdom he brought to the work and his deep commitment to Goethean phenomenology.

John was editor of the valuable book, *Nature's Open Secret*, containing Rudolf Steiner's introductions to Goethe's scientific writings, along with a substantial essay by John himself. He was also founder and editor of Adonis Press, which brought European texts on phenomenological science to English language readers.

In 2019, the institute's outreach and development coordinator, **Colleen Cordes**, retired after seven years of accomplished service. Deeply connected to the environmental and activist communities, she nicely complemented the central research and educational focus of the Institute. Along with her always positive and helpful attitude, she brought a sharp editorial eye to the preparation of *In Context*, which we will sorely miss. It was a pleasure working with Colleen and we are very grateful to have benefited from her effort and ability.

Elaine Khosrova joined our staff in October 2019. In her role as Outreach and Relations Coordinator, Elaine will help write grants and reports and also serve as a writer and editor for publications, manage our media platforms, and create materials to promote our events and courses.

As of this spring, another new colleague on staff is scientist **Gopi Krishna Vijaya**. With a PhD in physics (solar energy), Gopi's current work focuses on the assumptions behind many theories of modern physics, re-evaluating them in the context of phenomenology. He also researches the nature and implications of technology, including digital technologies. As part of his work, Gopi will continue to give talks and workshops at the Institute and elsewhere, as he has been doing for the past few years.

A New Challenge Grant!

A Nature Institute supporter has generously offered to donate up to \$5,000 as a matching gift. If we match the grant with your help, we will use the funds to support our education programs, allowing us to give scholarships to our courses, to charge reduced fees for programs, and to provide fellowships for young researchers.

So every dollar we receive by June 30 will be matched up to \$5,000. You can make a gift by check or credit card using the enclosed envelope, or by credit card through our website (<http://natureinstitute.org/friend>). *Thank you!*

Thank You!

We extend our sincere thanks to everyone who contributed goods or services to The Nature Institute between October 1, 2019 and March 31, 2020. The fact of your commitment and will to support our work warms and encourages us even more than the material substance of your support (important as that is!).

PLEDGES

Natalie Reed Adams
Nancy Kay Anderson
Johan Alvbring
Janet Barker
Betty Brenneman
Barry & Janet Lia
Malcolm Panthaki
in memory of Jimi K. Panthaki
Susan Starr
in memory of Yvonne C. Starr
Tish Streeten
Jo Valens & Michael Thomas
Mark Vecchio

DONORS & VOLUNTEERS

Clopper Almon
Carol Alpert
Rita Amedee
Tito Autrey
Amy Sue Axen
Penelope & John Baring
Peter & Peggy Barret
Felix Bauer-de Wit
Sylvia Bausman
Carol Beauvais
in memory of Charles Dameron
Klaus-Georg & Ursula Becher
Terrell & Jean Beck
Gerhard Bedding
Chris Bennett
Jeanne Bergen
Linda Bergh
Glenda Bissex
in memory of John Wires
Etienne & Rebecca Bissonnette
John Bloom & Joan Calderera
Rose Bohmann
Dave & Sheri Bolevice
Jody Bolluyt
Christina Bould
Steve Brannon
John Breasted
Eileen Bristol
William Brown
Walter Burkart
Mary Ann Carreras
Kim & Kathleen Cascone
Betsy Cashen
Burley & Mary Lynn Channer
Robert Coleman
Wendy Bobseine Conway
William & Frances Culley
George M. Curtis III
Lisa Damian
Jim Davis
Jean-David & Karen Derreumaux
Dennis & Marianne Dietzel
Charlie Doheny & Cate Decker

Charles Duquette
in memory of Kathy Haddad
Hanna Edelglass
Gordon Edwards
Rüdiger & Bettina Eichholz
Stella & Peter Elliston
Karen & James Emerson
Judith Erb
Douglas Feick
Nancy & William Foster
Nick & Gisela Franceschelli
Eileen Frechette & Ed Gutfreund
Bruce & Karen Frishkoff
Linda Frosch
Branko Furst & Christina Porkert
Mike Galbraith
Mark & Adrienne Gardner
Gary Gomer
Glynn & Anthony Graham
Alice Groh
in memory of Trauger Groh
Eileen Gunning
Daniel & Karin Haldeman
Joseph & Diane Haley
Paula Hall
Alexandre Hanley
Steven Hecht
Peter Heusser
Barbara Holdrege & Eric Dahl
Craig & Henrike Holdrege
Tom Holdrege & Peggy Reis
David & Brenda Hollweger
Jamie Hutchinson
Marjorie Iburg
Philip Incao & Jennifer Thomson
Wes & Joan Jackson
Ina Jaehnig
Whitney Jastram
Nelle Johansen
Kevin Jones
Michael Judge
Chrisoph & Annette Kaiser
Gloria Kemp
Elaine & Mitch Khosrova
Ann Kleinschmidt & Lee Coates
Lieselotte and Manfred Klett
Gabriele Knecht
Rita & Gary Kobran
Almuth Kretz
Jerry Leach
Elan Leibner
Rosa Letelier & Veronica Ravago
Yotam Lev & Gili Melamed-Lev
Martin Lockley
Peter Luborsky
Rich Lumma
Miriam MacGillis
Julius & Gertrude Madey
Rachel & James Madsen

Are & Karin Mann
Christine Marlow
Will Marsh
Lawrence & Robin Mathews
Kathleen Mayer
Drew M. McCaskey
in honor of Drew S. McCaskey
Rebecca McGrath
Mac & Ellen Mead
Binita Mehta
Meinhard Simon
Christoph & Annelien Meier
Mary Elizabeth Merritt &
Raymond Crowley
Fred & Masako Metreaud
Daphna H. Mitchell
Ross Mohan
Kartl Peter Möller
Kornelia Möller & Gerd Kroonen
Gregory Moore
Frank Mulder
Marcia Murray
Astrid Murre
Lin Notzelman
Jeffrey Onans
Frederick Otto
Bonnie Ozaki
Traute Page
Tim & Maggie Paholak
Linda Park & Cotter Luppi
Susan Peterson
Grace Ann Peysson
Martin & Janene Ping
Marisha Plotnik & Ihor Radysh
Gina Qualliotine & Richard Green
Susan Ramey
Renate Reiss
Jeanette Resnick
in memory of Don Resnick
Lesley Rice
Mark Riegner
Roger & Dory Rindge
Geoffrey Robb
Angela Rose
Laura Rubiano-Gomez
George & Leonore Russell
D. Joy Salatino
Jan Kees & Polly Saltet
Robin Sand
George Savastio
Signe & Christopher Schaefer
Ann Scharff
Tim Scherbatskoy & Carin Cooper
Thomas Schley
Erich Schneider
Steffen & Rachel Schneider
David Schwartz & Ronald
Sanchez Schwartz
David Seamon

Jeanne & Gregor Simon-
MacDonald
Peter & Phyllis Skaller
Amie Slate & Loren Smith
David & Christine Sloan
Douglas & Fern Sloan
Patricia Carry Smith
Jerome & Rebecca Soloway
Michael Soule
Joanne & Charles Spitaliere
Ann Stahl
Alice Stamm
Daniel & Connie Stokes
Candycy Sweda & Linda Williams
Chris Tekverk & Deborah
Enright
Jenny Telling
Mary Thieme
Thorwald Thiersch
John Trevillion
Roberto & Donna Marie Trostli
Carsten Ullrich
Mario & Donna Verna
Conrad & Claudia Vispo
Tonya Vitti & Dennis Burke
Adrian Walker
Christiana & Frank Wall
Andree Ward
Chip Weems
Gisela Wielki
Thomas Wilkinson
Christiana Williams
Nathaniel & Andrea Williams
Paula Williams
Christian Wittern
Dominic & Lauren Wolff
Waltraude Woods
Arthur & Heide Zajonc

ORGANIZATIONS

Fidelity Charitable, Donor-
Advised Fund
Kathy Yoselen Fierce
Determination Fund of the
Community Foundation
of Tompkins County
Rockefeller Family Fund, Inc.
R. Steiner Charitable Trust of RSF
Social Finance
Salvia Foundation
Seminary of The Christian
Community, N. America
Software AG Foundation
The Michael Foundation
Triskeles Foundation, Alexander
and Olivia Dreier Fund
in memory of Alexander Dreier
Urban Creatives LLC

The Intertwined Worlds of Zebra and Lion

CRAIG HOLDREGE

This article is a lightly edited version of a chapter in Craig's forthcoming book, Seeing Animals Whole—And Why It Matters, which will be published this year by Lindisfarne Books.

In the Savannah

Toward the end of a long day of observing animals, we were perched in our Land Rover in Moremi Game Reserve in Botswana. We were at a border between the dry bush savannah and the moist inland Okavango Delta with its waterways and tall grasses. The air was cooling and the landscape was bathed in the golden light of the setting sun. In our looking and listening, we expanded into this landscape and became happily lost in what we witnessed.

Swamp-loving antelopes, called lechwes (*Kobus leche*), were grazing near the high grass area. A lone hippo walked into a small pond and submerged itself. Other unseen hippos provided a bellowing chorus. Behind us a herd of elephants bathed in the mud; a young one rolled around, while others flung mud onto their backs with their trunks. Not far from them, zebras grazed, moving slowly along with heads lowered to the short grasses.

As I looked ahead, I saw a female lion emerge from tall grasses. She headed across the short brown grassland, advancing slowly but in a fairly straight line. The lechwes nearby continued to graze, apparently undisturbed by their main predator walking by. Soon a second lioness appeared and went in the same direction. She seemed to have as little interest in the potential prey in her vicinity as they had in her.

With binoculars I saw a third lioness lying on an old, rounded-off termite mound surrounded by tall grasses. She peered intently in the direction in which the other two lionesses were walking. After a time, she looked in other directions, descended from her vantage point, and moved around in the tall grass. If we hadn't already spied her on the mound, we would never have discovered her, so well did she blend in with the yellow-beige grasses. She moved

to the edge of the tall grass and crouched down low. A male lechwe was walking toward her as he grazed. When he was about 40 feet away, she darted out and made a brief sprint as the lechwe turned and fled in the opposite direction. The lioness soon stopped running. From our human perspective, we thought: not a terribly energetic attempt at a kill. But maybe it wasn't an attempt. The lioness moved off in the direction of the other two lionesses, which had disappeared into another area of tall grasses.

As all this was happening, the hippos were bellowing, and the sky filled with starlings that were gathering and flying toward the high grasses bordering the waterways. Their loud and high-pitched calls filled the air.

The intensity of colors and sounds, and the variety of forms, movements, and activities made a lasting impression. Reflecting back on this experience, I was struck by the "different worlds" present in one place—hippos, starlings, zebras, elephants, lechwes, and lions. Each is so different from the others, and each is in its own right a commanding presence. The different animal species seemed to give little heed to the others around them. Only when the lioness darted toward the lechwe did momentary interaction disrupt the seeming independence of species. What we call savannah, with its varied and changing composition of grasslands and trees, is home to all these animals, and yet each species pursues its own existence in keeping with its very specific way of being. What can we say about these different ways of being and their interactions? Let's ask the zebra and the lion.

Zebra and Lion in Their Worlds

With their bold and beautifully rhythmical black-and-white-striped coat, zebras stand out as a striking appearance in the green (rainy season) or straw-colored (dry season) savannah grasslands where they live. I will be referring mainly to the plains zebra (*Equus quagga*, formerly designated as *Equus burchelli*¹). Its range extends from East Africa down to South Africa.

As grazers, zebras live in the midst of their food—grasses of the savannah. When there is ample growing grass, zebras spend about 14 hours of a 24-hour day grazing. During the dry season, they may spend 19 hours grazing.² As we have seen [in a previous chapter], grass is very tough and not easy to digest. But it is abundant in the savannah, and zebras take in large amounts of grass each day. Zebras prefer the stems and leaf sheaths of short grasses, but will also feed on leaves and grass seeds.³

With head lowered to the ground, a zebra stands and walks slowly along as it grazes. Its agile lips, its nostrils, and its large jaws are in constant movement as it clips off the grass with its large incisors. With its tongue it brings the food between its massive cheek teeth (premolars and molars), and in a rhythmical circling motion the grass is sheared, ground, and moistened with saliva before it is swallowed. When we imagine this activity occurring between 14 and 19 hours every day, we realize not only the focal nature of grazing in their lives, but also the persistent repetitive activity that flows at each moment into their interaction with grass.

No mammal is able by itself to digest cellulose, which is a major component of grasses. All herbivores have developed some organ that provides an environment in which cellulose-digesting microorganisms can thrive. Unlike in ruminants, such as the bison or the cow, the zebra does not have a four-chambered stomach with an expansive rumen housing microorganisms. Nor does it regurgitate its food and chew cud. The zebra's digestive organ that is comparable to the rumen is an enlarged portion of the large intestine (the caecum), situated in the rear part of the digestive tract. Food passes more rapidly through a zebra than it does through a bison or comparably sized antelope and is less fully digested when excreted.⁴ In compensation for its more rapid and less intense digestive process, the zebra takes in more food during the day than does a ruminant.

Zebras spend most of the day standing and walking—approximately 20 hours a day. They can sleep while standing. Their grazing lives demand endurance in head, digestion, and limbs. Depending on the conditions, zebras may graze in a fairly small area for a period of time or undertake long daily journeys to graze. For example, in the dry season at the Makgadikgadi Pans in Botswana, zebras may walk many miles outward from watering holes—up to 21 miles—to desired foraging areas.⁵

Zebras also migrate from one area to another in the course of a year, often moving to reach areas of rainfall and the period of grass growth.⁶ Such migrations are well

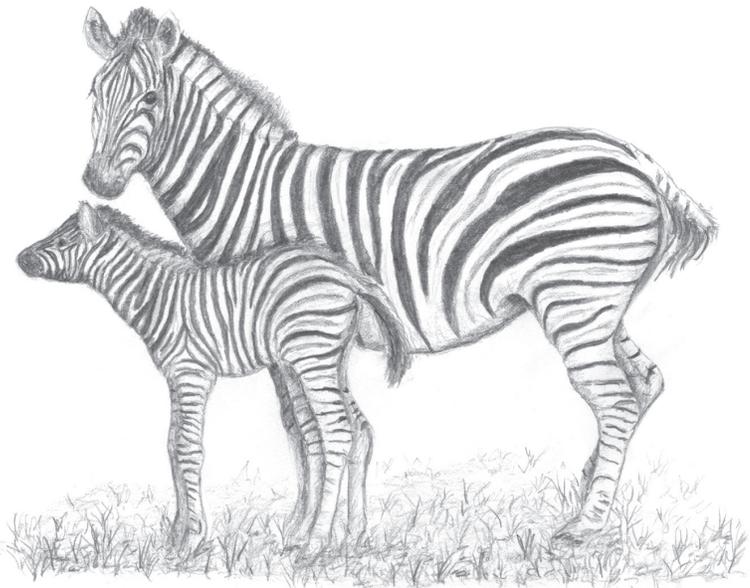


Figure 1. Adult female and young foal of plains zebra (*Equus quagga*) in Etosha National Park, Namibia. (All drawings in the article are by the author unless otherwise noted.)

known in the Serengeti and have been recently recorded in Botswana, with zebras traveling more than 150 miles in one direction to reach a new seasonal home. They may average around 12 to 15 miles per day on journeys that take one to three weeks, but sometimes they travel over 30 miles in a day.⁷ That's endurance!

Migrating zebras will pass through areas that offer forage similar in quality to the grassland they are heading for, but they don't stay at them. So there is more to migration than grass availability, and much remains a riddle, including how the animals find their way to such far-off destinations.

When migrating, zebras mostly walk, although they can trot, canter, and gallop like horses, which are close relatives. The faster gaits are typically observed when zebras are fleeing a predator, and they often reach a speed of over 30 mph. They have the stamina to outrun lions if they have an adequate head start. After a longer bout of running, a zebra does not collapse in exhaustion, but remains standing and typically begins to graze again. Running is also a primary play activity amongst zebras. Here a description by Cynthia Moss from her book *Portraits in the Wild*:

The foal may gallop by itself, running around its family and racing up to 150 yards away. Foals may also play racing and chasing games with each other, and even with foals from neighboring groups.... The animals in bachelor groups, especially in those made up of young animals, are very high-spirited and playful. Their running games turn into races, with the whole group of them galloping across the plains at full speed.⁸

Just as it can lower its head to ground while standing, a zebra can raise its head above the height of its torso. With good senses of hearing (ears are mobile and can be turned in all directions) and smell, and eyes on the side of its head giving it a large field of vision, a zebra can spread its awareness out into its surroundings. A major focus of awareness and interaction is with other zebras in its group or herd. Behavioral ecologist Richard Estes remarks, “Individual members rest, feed, move, groom, dustbathe, suckle, and excrete on much the same schedule, as though these activities were all infectious.”⁹

The plains zebra lives in groups with usually one stallion, a number of mares, and their offspring; the mares are not necessarily related.¹⁰ These groups are stable over long periods of time, while the larger aggregations of hundreds or even thousands of zebras—zebra herds—are ephemeral entities that change in composition, or grow and shrink depending on a variety of conditions.



Figure 2. A lioness stalking.

The lion demands of us a radical shift in perspective to see its way of being in the world. Take grass. While we can say it is the same material and may in one sense look the same for a zebra and a lion, the meaning of grass in the lives of these two animals could hardly be more different. For a zebra it is food, and much of its daily activity consists in feeding and digesting grasses. A lion watching zebras doesn't suddenly come up with the idea that life would be much more comfortable hunting grass than hunting those zebras. For a lion, grass is a space to rest, hide, and stalk when long; when short, it's an area to saunter, attack, and often to be noticed by prey.

While zebras spend 20 hours a day standing, walking, and grazing, lions spend about the same large portion of the day resting.¹¹ As Cynthia Moss writes, “Lions are consummate resters; they stretch out in sometimes ridiculous positions, utterly relaxed and apparently without a worry in the world. This quality makes them a difficult animal to study in a way—the scientist is forever in danger of falling asleep with his subjects.”¹² Imagine a group of

lounging, straw-colored lions on a warm afternoon and you can easily understand why Anne Morrow Lindbergh was moved to say they appear “poured out like honey in the sun.”¹³

Such a group of lions will often consist of a few females, their cubs, and perhaps a male or two. They all belong to a larger pride of lions comprised of those lions that peaceably aggregate and interact in a given region. Smaller groupings within the pride change continually, but whole prides have large territories (averaging around 35 square miles) that they defend against other prides.¹⁴ The degree of social interaction within groups of lions is unique among cat species.

As with zebras, play behavior provides a vivid picture of the way lions live in their bodies and of the kinds of movement and attentiveness they express. George Schaller, in his seminal study of lion behavior, describes lion cubs at play:

The cub paws a twig, then chews it. When another cub passes, he lunges and bites it in the lower back. It turns and swats, then walks away. The cub sits. Suddenly he stalks a cub and rushes. The one attacked rolls over with a snarl and both grapple. The cub desists in its attack and bites at a tuft of grass instead. He then flops on his side. After lying briefly on his back and waving his feet, he rolls over and watches other cubs play. One of these ambles closer. He crouches behind some grass, then rushes and swats and in the same motion turns to another cub and nips it in the flank. The other cub whirls and hits him with a paw. He leaves. Two cubs wrestle, and he grabs one of these with his paws. One clouts him in the face.¹⁵

While wrestling is unique to play, other activities such as chasing, stalking, rushing, pawing, and swatting are all relevant when at a later age lions start hunting. But in play, everything occurs in a relaxed and unfettered way.

After a long day of rest, lions often rouse to activity

in the late afternoon or early evening. As their drive to hunt awakens, they begin moving through their environment. These beings, which can be so carefree, loose, and unfocused, can move seamlessly into focused and forward-striving action. As a lion searches for prey, its senses of sight and hearing let it reach out into the surroundings and detect what is focal for it—potential prey. Favored prey animals are fairly large herbivores such as zebras, wildebeest, and other large antelopes.¹⁶ These animals are generally larger than lions. While an adult male lion can weigh as much as an adult zebra, lionesses, which are the primary hunters, weigh only about half as much as male lions. If preferred herbivores are rare in an area, then lions will hunt much smaller prey, and in some areas they hunt the large and powerful Cape buffalo.

When a hunting lion discovers a nearby zebra, it may immediately burst into a sprint and attack.¹⁷ But lions also often stalk. During daylight, this entails finding tall grasses or other vegetation for concealment, while at night darkness provides ample cover. Most kills are made at night—a testament to the lion's keen sensory and motor abilities. Hidden in vegetation or in darkness, a crouching lion waits with all muscles tensed for its prey to approach. Its attention is fully focused on the prey and its movements. To close in on the prey, the lion may sneak-crouch toward it.

A sudden thrust of activity follows as the lion sprints for its prey and lunges for the nape or throat, which it pierces with its canines. The forelegs grasp the prey and pull it down. The lion may tear into the neck and rip open the windpipe, so that the animal soon expires. Or, it may open its gaping jaws, grab and close the prey's muzzle, suffocating it. Chomping into the flesh and shearing off chunks with jagged cheek teeth, the lion swallows without any chewing. An adult lion may devour from 20 to 50 pounds of meat at one feeding, so to speak of gorging here is to use a descriptive and not a derogatory term. A pride of lions feeding on one zebra can consume the entire carcass in 30 minutes.¹⁸

A lion cannot outrun a zebra or wildebeest. In its short sprint, it must overtake the accelerating prey. The lion has no endurance in such a sprint. Hunts are often not successful because the prey simply outruns the lion. When lionesses hunt together, they are more likely to have success than when they hunt alone, since they often form a kind of loose circle around an area with prey, and when one lion attacks and the animal flees, it may be unwittingly driven into the area where some of the other lionesses are hidden.

After a successful hunt, the lion usually retreats to a secluded spot and rests, sleeps, and digests for many hours. In the lion we meet a being that lives in extremes between utter relaxation and focused powerful activity.

The Parts Express and Embody the Whole

The unique way of being of an animal expresses itself in its behavior, physiology, and in all its organs and structures. Every part of the zebra expresses zebra; every part of the lion expresses lion. However, it is one thing to “know” that all parts of the animal are expressive of the whole, and another matter to *see* how the whole is at work and embodied in every aspect.

I will focus on skeletal morphology and branch out from there. The skeleton is the most definitively formed structure in an animal. It resists decomposition when the animal dies and can then be studied as a clearly formed memory of the whole animal. In exploring this memory in detail and relating it to other aspects of the animal, the whole can come to life in us.

The Limbs

Like its close relative, the horse, the zebra rests upon long, stable columns of bone (Figures 4 and 5). Born with well-formed limbs, a foal tries to stand right after birth. After about 10 minutes, it can stand; it is walking after half an hour; and before the first hour of its postnatal life is over, it is cantering and running about.¹⁹ For an animal to be carrying out its spectrum of movements already an hour after birth shows us that its limbs come ready to act in the world. This is in stark contrast to lions, which are born helpless and kept well hidden. Lion cubs can walk after 10 to 15 days and run around at 25 to 30 days, and they can keep up with the pride after about seven weeks.²⁰

The newborn foal has proportionally very long legs and a relatively short body (see Figure 1). Over the next few years, the torso doubles in length, while the legs grow only half again as much to reach the adult proportions.²¹

The upper part of a zebra's legs has strong, short muscles that are embedded in the torso. The upper leg bones (which are comparable to our human upper arm and thigh bones) do not extend beyond the torso. The markedly elongated lower parts of the legs below the body (comparable to our lower arms and legs, hands and feet) have few muscles. This makes the lower leg of the zebra thin and bony—and relatively light.

Long tendons, which connect muscles to bones, extend from the upper muscles down into the lower legs and feet. In zebras (and horses) some muscles in the lower leg are actually more tendon than muscle and tendons also replace muscle.²² Tendons are more fibrous than muscle and cannot actively contract. The forefeet and hind feet consist of three bones, and there are no muscles at all in the feet. The foot bones are held together by tough, almost bone-like ligaments.

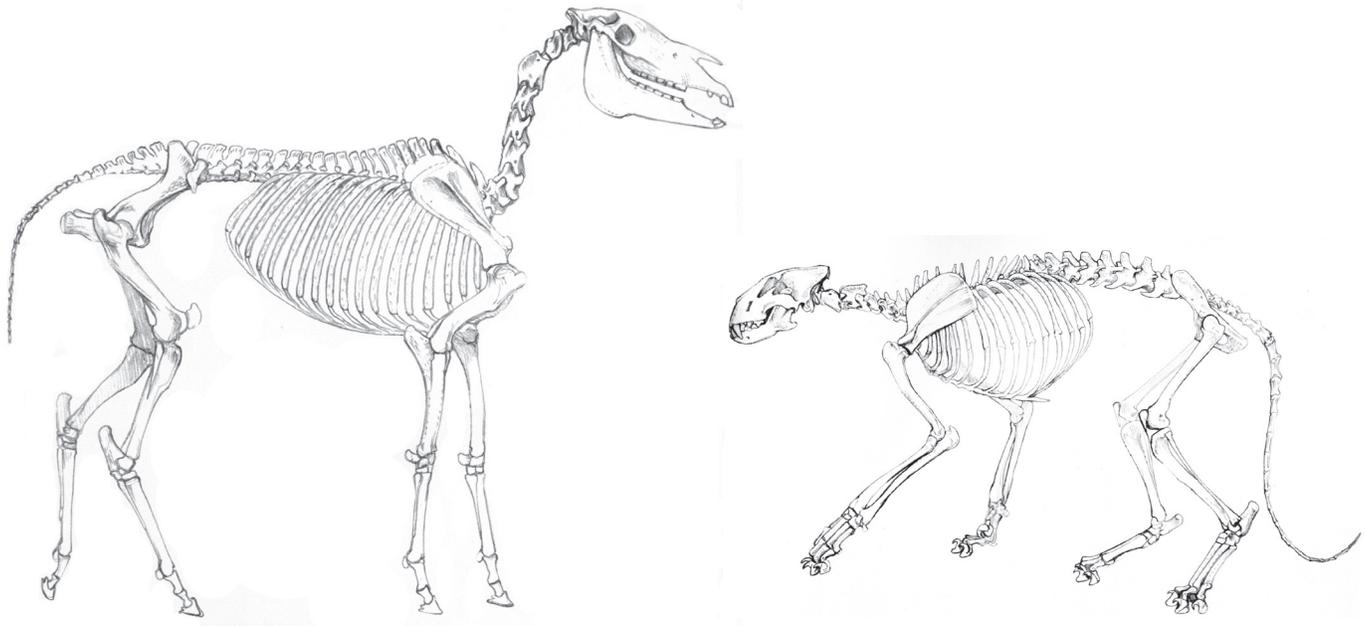


Figure 3. Zebra and lion skeletons. (Adapted from Kingdon 1977, vol. IIIa, p. 393 and Kingdon 1979, vol. IIIB, p. 144)

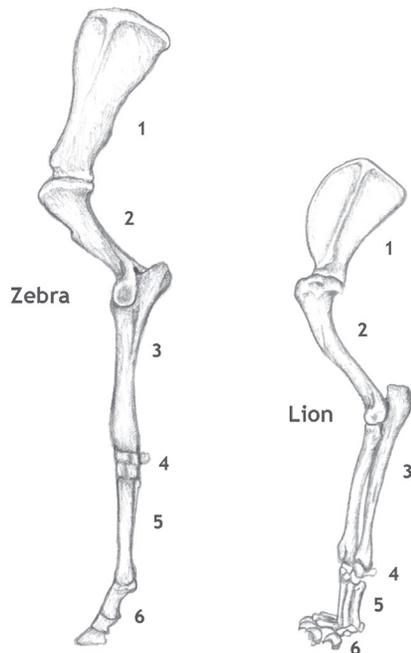


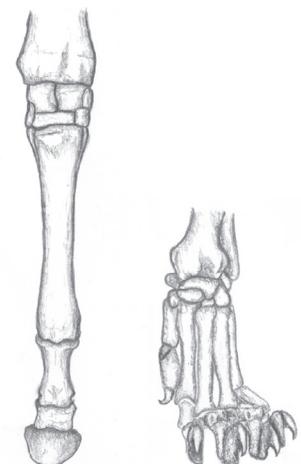
Figure 4. Forelimb of zebra and lion. 1: scapula; 2: humerus; 3: ulna and radius (in zebra fused together); 4: carpals; 5: metacarpals; 6: phalanges (toe bones).

This structure of bone, ligaments, and tendons provides stability, so that the zebra can stand with virtually no muscular effort.²³ Its muscles can relax in sleep but the zebra does not collapse. In a sense, the zebra's limbs become living architecture. The stability of the zebra limb is connected with the strength of bones, the tight joints, the configuration muscles, joints, and tendons, and, importantly, the fact that the limb has fewer bones and joints than the limb of other land mammals.

The zebra's forelimbs carry about 70 percent of the body weight. We human beings can rotate our lower arm around its axis; this is only possible because we have two bones—the ulna and radius—that allow this movement. In the zebra, these bones are fused to form one straight, stable bone, which is the longest in the zebra's body (Figure 4). Below it a “wrist” is formed by eight thick, compressed bones called carpals. These carpals have horizontal surfaces that rest upon one another and provide stability but little flexibility (Figure 5).

The zebra does not stand upon feet with five toes but, rather, upon one enlarged toe that ends in the thick, horned sheath of the hoof. Fewer bones mean fewer joints; the fewer the joints, the fewer the muscles. This all decreases mobility and flexibility, while the stoutness of the remaining bones, along with the fusion of ulna and radius, increases stability. In other words, the flexibility the zebra loses in the leg is compensated for by the stability and strength it gains by becoming living architecture. The zebra can stand, walk, trot, and gallop with great endurance, but cannot crouch to the ground, or easily scratch an ear with its hoof.

Figure 5. Detail of lower forelimb of zebra and lion, viewed from the front.



The ability to move at high speed for long distances is intimately connected with the structure of the limbs, a connection that has been researched in detail in horses, which have virtually the same body structure as zebras.²⁴ The hinge-like joints and arrangement of ligaments and tendons allow movement mainly in the forward-backward plane, and at the same time, they restrict side-to-side movement. A relatively small effort of muscle contraction in the upper legs results in a large motion of the long and light lower legs. The elastic tendons in the lower legs and feet act like a spring when the zebra is running, so that with each landing the zebra is propelled ahead. For a zebra, running is hardly more strenuous than walking.

How different is the lion, which tires after a short, forceful sprint, but is capable of such supple and agile movement. This is embodied in its limb structure. There are many joints in the lion's limbs, and the bones are not so tightly connected as in the zebra (see Figures 4 and 5). The wrist bones, for example, have rounded surfaces—an expression of mobility. They do not possess in themselves the stable architecture of the firmly set, horizontally placed carpals of the zebra. The ulna and radius are two separate bones, allowing rotation of the forelimb by muscles. This rotation comes into play in many of the lion's activities—when it grasps its prey, holds a chunk of a carcass, or cleans itself with its paws. Compared to those of the zebra, the lion's limbs are short and stocky, embedded in an array of muscles.

The lion's front feet have five toes, the back feet four. The body's weight rests on the pads beneath at the base of the outermost toe bones in each foot, extending the lion's characteristic softness and buoyancy far into the periphery of its limbs. Another element of lion movement—the powerful forward thrust culminating in the leap for prey—also comes to expression in the feet, namely in the claws. Held hidden in the paw, they lash out, gash into the prey, and then retract. The activity of the claws in this hunting sequence vividly reveals the way of the lion as a whole—springing forward, penetrating, and withdrawing into inactivity.

Overall, we can say that the lion's stance and movement are directed and modulated at every moment by muscle. By living in the medium of muscle, the lion is capable of utmost force and complete relaxation. Moreover, every movement is characterized by a polarity of tension and restraint, power and suppleness.

From Neck to Tail

The zebra has a comparatively long neck that allows freedom of movement in the head. It can lower its head to the ground for grazing, turn its head from side to side, and also raise its head above the level of the body. A typical sight is to see a zebra resting its neck on the back of

another zebra. The ridge of the neck supports the mane with its upright hair.

The middle part of the zebra's vertebral column is fairly rigid, although it consists of more vertebrae than the lion's. As in the legs, interlocking surfaces and strong ligaments make the spine a stable, horizontal axis supporting the body through its very structure. This part of the spine keeps essentially the same form under all conditions, whether the zebra is galloping or lying.

The lion's neck, like its limbs, is short and very strong. We need to imagine the neck strength it takes for the lion to pull down a prey animal that it has clamped into with its teeth. In males, the neck (and, of course, the head) is accentuated by the long-haired mane. The middle part of the lion's spine is much more flexible than the zebras. Its capacity to flex, extend, and bend laterally is much greater. When a lion sprints, the spine rhythmically oscillates between concavity in expansion and arching convexity in contraction. And lying at rest, the lion can stretch out lengthwise or curl up. Because of this flexibility, the body can follow, in its form, any irregularities of the surface upon which the lion lies.

The vertebral column has its continuation in the tail, which is an animal's characteristic extension into the world behind it. The zebra's streaming, long-haired tail emphasizes its vertical aspect. The tail hangs down, is blown by the wind, but also swishes to and fro. The muscular, bony core of the tail extends only into its upper half, while the rest consists of long strands of hair, a substance in which the animal no longer lives. In contrast, the lion lives in its muscular tail almost to the end of its tufted tip. The lion holds its tail actively, not letting it hang down or drag. Perhaps more than any other organ, the tail with its fine undulating movements expresses the lion's momentary state and the inner direction of its alertness. The lion's tail embodies movement and expression, while the zebra's tail, like its lower legs, is more of an organ that is moved.

The Heads of the Zebra and Lion

Through its head, an animal interacts with the world in manifold and characteristic ways. The senses of sight, hearing, smell, and taste are centered in the head, and the sense of touch is most sensitive in the head (tongue, lips, snout). The animal breathes through nose and mouth. And with its jaw—the limb of the head—it feeds.

The zebra has a long head, and just as with the limbs, the part of the head farthest from the body proper is elongated. This front-most portion of the skull is formed by long, tapering bony plates. The snout is not muscular, and its form reveals the underlying bone structure in the same way the lower limbs appear as "skin and bone."

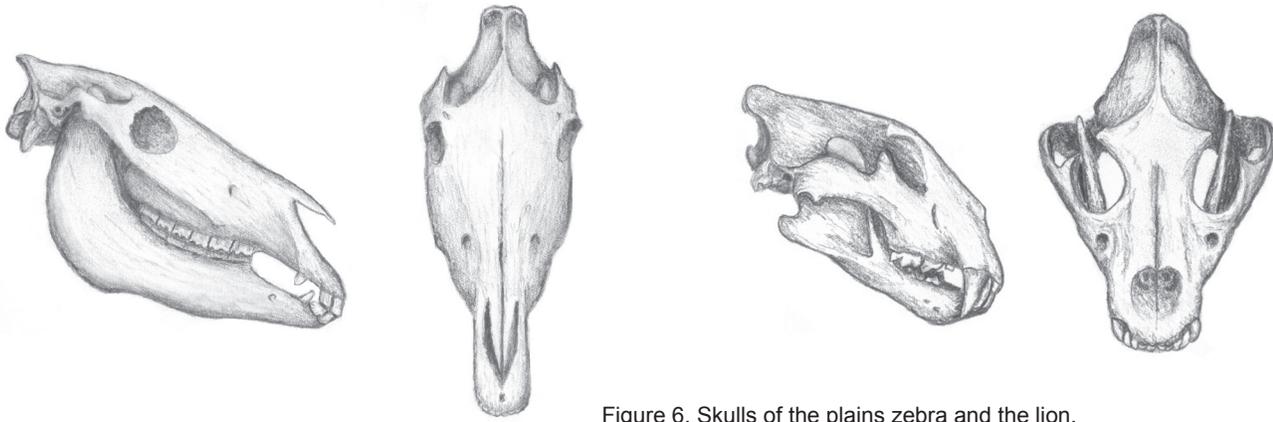


Figure 6. Skulls of the plains zebra and the lion.

The head's high, broad rear portion is embedded in the neck and jaw muscles. The latter insert into the massive rear section of the lower part of the jaw and connect to the upper, rear part of the skull. The center of gravity is therefore at the rear (body-near) portion of the head, just as large leg muscles are anchored within the body.

The zebra's organs for perceiving what is around and behind it are the nose, eyes, and ears. The eyes are positioned not only sideward, but also quite far back in the skull. The zebra cannot focus on what is directly before it, and it can hardly adjust focus through changing the shape of its lens. In compensation, the zebra can see well in dim light and has a wide field of vision. It sees most sharply what is far away and is sensitive to what moves in the horizontal plane. So while it is grazing with head lowered, it can be aware of what is around and behind it. It has no need to focus on the grass it is feeding on—grass is a field through which it moves, not a point of attention.

So zebras are at home visually in the expanses of the surroundings, which includes awareness of the herd and of predators. Flight from a lion is not movement that involves a focal point; its direction is "away from." By contrast, the lion intently focuses its forward-oriented eyes upon the prey—what is before it and toward which it moves with total absorption.

As figure 6 illustrates, the zebra's jaw is dominated by long rows of large cheek teeth. Each row forms one uniform surface that meets with its counterpart in grinding. The image of persistent grinding in which surface meets surface is paralleled by the image of the zebra standing or running with its hard hooves striking the surface of the earth.

Like the cheek teeth, the front teeth (incisors) form uniform rows. All these teeth end evenly, so that the zebra can easily clip grass. Characteristically, the one tooth type in mammals that is pointed and never forms surfaces that meet—the canine—is present in the zebra only in a rudimentary form.

The lion's broad, compact skull is almost as wide as the shoulders and hips (see Figures 6 and 7). The back half of the skull is surrounded by a thick layer of muscles. The space between the broad arcs of the cheekbones and the cranium is filled with the massive jaw muscles. The skull ends in the front in the powerful gesture of the enormous canine teeth.

The lion's canines are as deeply rooted in the upper jaw as they protrude from it. The pointed and conical form of the canines dominates the structure of the other teeth as well. In great contrast to those of the zebra, the lion's incisors are not broad and spatula-like; rather, they are small and have the form of short spikes. The cheek teeth do not form flat surfaces but possess pointed cusps that give them a jagged appearance. When the jaw clamps down (the jaw moves vertically with virtually no lateral movement), the surfaces pass by one another, forming shears that pierce and cut the flesh of the prey.

It is as though the forward thrusting movement of the lion has become frozen in the form of the canines. As we have seen, the same is true of the claws.

There is a further accentuation of this tendency in the frontal positioning of the eyes, which lie quite forward in the short skull. The gaze holds the prey visually before the lion grasps it with claw and tooth. With eyes that are oriented forward, the lion can focus on what is directly in front of it. It can see well in darkness and evidently needs little light to find and kill prey. When there is no moonlight bringing silvery illumination to the savannah, they are more successful in nocturnal hunts.

The male's mane is a majestic image of the forward orientation, which comes more to realization in the activity of the female, who is the dominant hunter.

Anyone who has spent some time where lions live will not forget the experience of hearing roaring lions. Both males and females roar. Roaring typically begins with soft moans, and then a series of "full-throated, thunderous

roars,²⁵ and finally a series of grunts. This whole sequence can last up to a minute.²⁶ The deep and loud roars resound far into the surroundings and are often answered by the roars of other lions. The roar grips the whole animal; its jaw is opened wide, and the air streams out and expands the lion far out into the world.

Contrasting Ways of Being

The rhythmically striped zebra attends both to what is close to it—its fellow zebras and the grass it spends countless hours grazing—and to the broad surroundings that may include a distant water hole or its predators.

It lives on the basis of its robust bone structure. Bone is life compressed into solid, enduring form. The leg and foot skeleton has a reduced number of bones, which reduces flexibility, and those that remain grow large and sturdy and in some cases fuse with each other. The stout bones fit tightly together in the joints. The zebra stands upon the ground in the same way that it stably rests upon its own limb bones.

The hooves, which consist of protein, follow the tendency of the robust bone structure—each hoof is a highly thickened and solid toenail that wraps around the last toe bone and provides a solid and stable surface on which the zebra stands and meets the ground when walking or running. The hooves hit the ground when running; the teeth grind grass between their hard surfaces. The zebra meets its world in activity through hard, compact surfaces.

The tendency toward the formation of unified, hard surfaces that we find in the limbs is mirrored in the zebra's jaw, which is its limb in the head. The rows of large cheek teeth are covered with strong enamel, and the zebra spends much of its life grinding highly resistant grass between its teeth.

As it can grind for hours on end, so it stands, walks or runs for most of the 24-hour day. The zebra shows stamina in all its activities—grazing, grinding, digesting, standing,

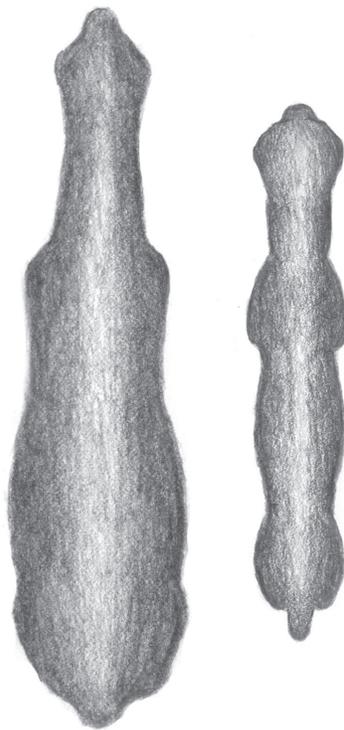


Figure 7. Overhead silhouettes of zebra and lion.

running. Such stamina and constancy is a central aspect of the language of the zebra. Endurance is the physiological and behavioral expression of the stability revealed in the skeletal anatomy.

In contrast to the zebra, the lion lives in its muscles, which function through an interplay between tension and relaxation. The life of a lion oscillates between extremes—focused, powerful action in the hunt, followed by complete relaxation and lassitude.

Stocky limbs and skull express in form the predominance of muscle in the lion. Since its legs are bent when stalking, the lion must draw on enormous body strength to hold its body close to the ground. This concentrated tonicity erupts into the sheer might of its sinewy being when the lion surges, pulls its prey to the ground, and sinks its teeth into the flesh. The lion feeds ravenously upon the element in which it lives—muscle.

Only an animal that lives to such a degree in the power and tension of muscularity is capable of such complete relaxation. A lion can sleep curled up and entwined with the bodies of its kin, but it could never sleep while standing. It would collapse the moment its muscles relaxed. When the rested lion rises, it stretches every sinew. (Think of your pet cat arching or “concaving” its back.)

Lion activity is not a matter of either force or relaxation separately. In the smoothness, softness, and agile muscular modulation of a moving lion, we can observe the interpenetration of tension and relaxation. The paws roll softly over the ground, and the tail undulates. As seen in the muscular fluidity of body movement, flexibility through joints rather than bony stability predominates in the lion. This quality also manifests in behavior—for example in playful chasing, hitting, and biting between members of a pride. Lion play is a form of “relaxed tension” and reflects the lion's way of life as a whole.

I think we have touched something of the unifying qualities of each of these animals. We can begin to see how different and distinct “parts” can also reveal to us something of the integrated wholeness of the animal. Such wholeness can reveal itself in every aspect of the animal. Whether it does or not depends on our capacity to discern relations between seemingly separate aspects of the animal. Our knowledge will never be “complete”; wondrous riddles will always remain that give a hint at how rich and deep the organic world truly is.

One of those riddles is the beautiful stripes of the zebra—a riddle that I address elsewhere.²⁷

NOTES

For the notes and references to this article, please see <http://natureinstitute.org/pub/ic/ic43/zebralion.pdf>.



NON-PROFIT ORG.
U.S. POSTAGE
P A I D
GHENT, N.Y.
PERMIT NO. 5

20 May Hill Road, Ghent, NY 12075

Please contact us if you wish to be removed from the mailing list

“Beauty is the convenient and traditional name of something which art and nature share, and which gives a fairly clear sense to the idea of quality of experience and change of consciousness. I am looking out of my window in an anxious and resentful state of mind, oblivious of my surroundings, brooding perhaps on some damage done to my prestige. Then suddenly I observe a hovering kestrel. In a moment everything is altered. The brooding self with its hurt vanity has disappeared. There is nothing now but kestrel. And when I return to thinking of the other matter it seems less important. And of course this is something which we may also do deliberately: give attention to nature in order to clear our minds of selfish care.”

Dame Iris Murdoch, *The Sovereignty of Good* (2007)