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Charles Darwin and the Evolution of Beauty
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Monday October 12
The Evolution of Beauty

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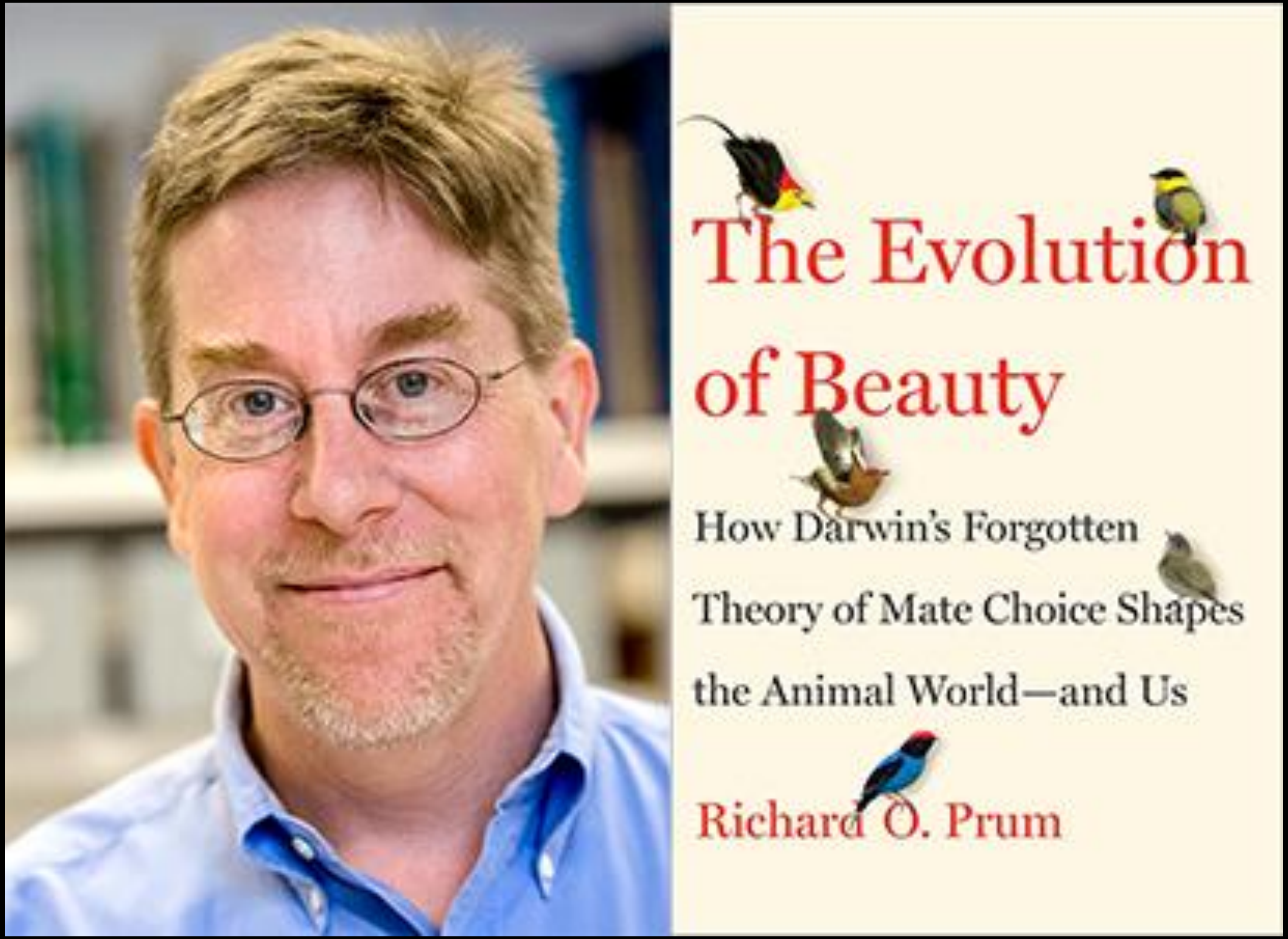
- Richard O. Prum, *The Evolution of Beauty: How Darwin’s Forgotten Theory of Mate Choice Shapes the Animal World – and Us* (New York: Doubleday Press, 2017) 17-88; 303-342.



https://prumlab.yale.edu

- How does sexual selection shift between Darwin’s *Origin of Species* and *Descent of Man*?

“…in *Origin*, Darwin saw sexual selection as simply the handmaiden of natural selection, another means of guaranteeing the perpetuation of the most vigorous and best-adapted mates. This view still prevails today. By the time he wrote *Descent*, however, Darwin had embraced a much broader concept of sexual selection that may have nothing to do with a potential mate’s being more vigorous or better adapted per se, but only with being aesthetically appealing, as he stated clearly for the mesmerizing example of the Argus Pheasant: “The case of the male Argus pheasant is eminently interesting, because it affords good evidence that the most refined beauty may serve as a sexual charm, *and for no other purpose* [emphasis added].” (Prum, 25-26)

https://www.youtube.com/watch?v=3IrlBKv1sE0

Great Argus Pheasant Mating Dance

"Moreover, in *Descent*, Darwin viewed sexual selection and natural selection as two distinct and frequently independent evolutionary mechanisms. Thus, the concept of two distinct but potentially interacting and even conflicting sources of selection is a fundamental and vital component of an authentically Darwinian vision of evolutionary biology. As we will see, however, this view has been rejected by most modern evolutionary biologists in favor of Darwin's earlier view of sexual selection as just another variant on natural selection." (Prum, 26)

Sexual Selection

- **Sexual selection** is natural selection for mating success.
- It can result in **sexual dimorphism**, marked differences between the sexes in secondary sexual characteristics.
- Male showiness due to mate choice can increase a male's chances of attracting a female, while decreasing his chances of survival.

Natural Selection vs Sexual Selection

• Utilitarian, functional	• Showy, elaborate
• Solves a problem	• Impresses an audience
• Sensible	• Whimsical
• Economical	• Wasteful
• Fixed	• Changeable
• Constructive	• Destructive
• Dull	• Exciting

Top: Incorrect
Bottom: Better – to be discussed
How is anthropocentrism present in both?

- How do we understand the individual agency of organisms within Darwinian evolution?
- According to natural selection?
- According to sexual selection?

Chance
Will
Consciousness
Interaction
Coevolution
Purpose
Purposiveness
Altruism
Cooperation
Competition
Function/Utility

“Within Darwin’s argument for mate choice in *Descent* was another revolutionary idea: that animals are not merely subject to the extrinsic forces of ecological competition, predation, climate, geography, and so on that create natural selection. Rather, animals can play a distinct and vital role in their *own* evolution through their sexual and social choices. Whenever the opportunity evolves to enact sexual preferences through mate choice, a new and distinctively *aesthetic* evolutionary phenomenon occurs. Whether it occurs within a shrimp or a swan, a moth or a human, individual organisms wield the potential to evolve arbitrary and useless beauty completely independent of (and sometimes in opposition to) the forces of natural selection.” (Prum, 27)

- Is sexual selection completely useless and nonfunctional?

"If the isolated populations diverge far enough from each other, the process of aesthetic sexual selection may result in an entirely new species – a process called **speciation**. According to this theory, aesthetic evolution is like a spinning top. The action of mate choice creates an internal equilibrium that determines what is sexually beautiful within a population. But random perturbations of the top – either internal forces like mutation or external factors like population isolation by a geographic barrier – can cause the top to spin away toward a new equilibrium.

The overall result is that mate choice fosters the evolution of ever-escalating and ever-diversifying standards of beauty among populations and species. Practically anything is possible – an idea for which there is ample evidence in some of the birds that populate these pages. I call them aesthetic extremists for good reason." (Prum, 44)

- Later in the book, how does Prum connect sexual selection to same-sex behavior – in birds and other animals?

“Here, I propose that human same-sex behavior, like many of the sexual traits and behaviors discussed in the preceding three chapters, might have evolved through female mate choice as a mechanism to advance female sexual autonomy and to reduce sexual conflict over fertilization and parental care. According to this aesthetic hypothesis, the existence of same-sex behavior in humans is another evolutionary response to the persistent primate problem of male sexual coercion. Although I think that *all* human same-sex behavior might have evolved to provide females with greater autonomy and freedom of sexual choice, I address the evolution of female same-sex behavior and male same-sex behavior separately because I think that their evolutionary mechanisms differ substantially in detail.” (Prum, 306-7)

- How do we understand the individual agency of organisms within Darwinian evolution?
- According to natural selection?
- According to sexual selection?

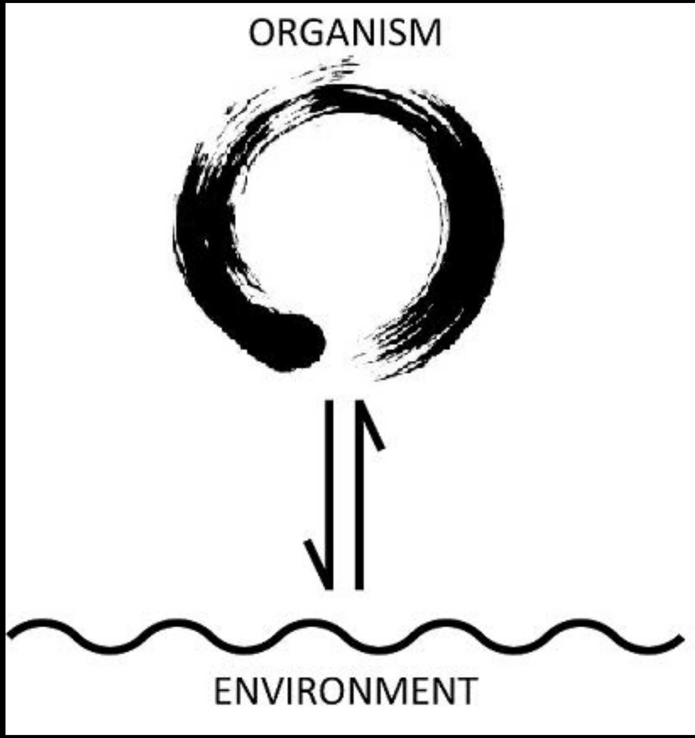
“As Darwin hypothesized, with the evolution of sensory evaluation and choice comes the emergence of a new evolutionary agency – the capacity of individual judgments to drive the evolutionary process itself. Aesthetic evolution means that animals are aesthetic agents who play a role in their own evolution.” (Prum, 323-4)

“Myriad organisms have then evolved to use their senses to make sexual, social, and ecological choices. Although animals are not conscious of their role, they have become their *own* designers…The concept of aesthetic mate choice is at the heart of Darwinian aesthetics, and it remains a revolutionary idea to this day.” (Prum, 324)

"The aesthetic view of life reveals new ways in which evolutionary biology has been hampered by failing to recognize the aesthetic agency of individual animals. For example, we can see that much of the scientific study of sexuality has been characterized by a deep anxiety about the subjective experiences of sexual pleasure and desire – especially when it's a matter of *female* pleasure. A symptom of this anxiety is the great lengths that evolutionary biologists have gone to avoid engaging sexual pleasure and desire altogether." (Prum, 324-5)

Autopoesis Autonomy Sexual Selection

Autopoesis = Self creation
The term autopoiesis (from Greek αὐτο- (auto-), meaning 'self', and ποίησις (poiesis), meaning 'creation, production') refers to a system capable of reproducing and maintaining itself.



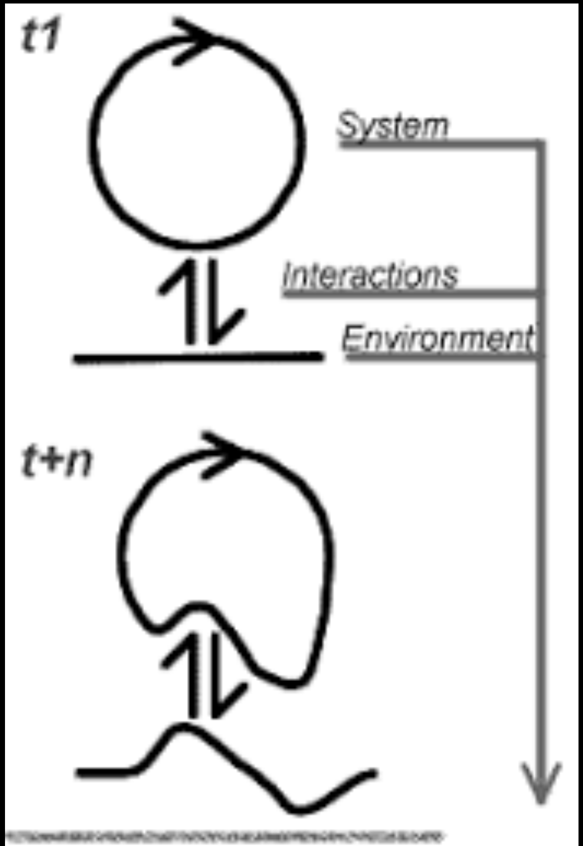


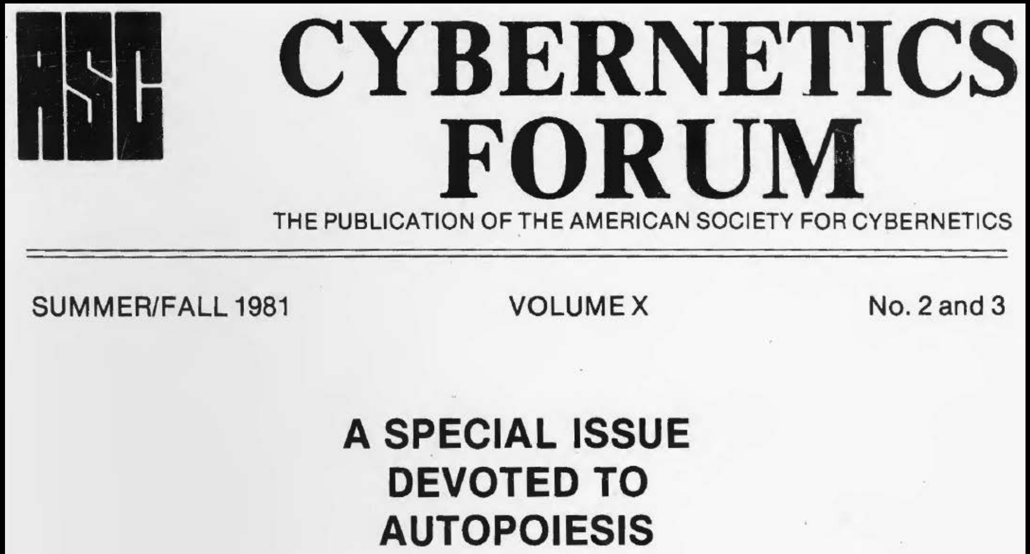
Figure 1: System - environment coupling

There is a strong current in contemporary culture advocating ‘holistic’ views as some sort of cure-all... Reductionism implies attention to a lower level while holistic implies attention to higher level. These are intertwined in any satisfactory description: and each entails some loss relative to our cognitive preferences, as well as some gain... there is no whole system without an interconnection of its parts and there is no whole system without an environment.

From: Varela (1977) "On being autonomous: The lessons of natural history for systems theory.” In: George Klir(ed.) *Applied Systems Research*. New York: Plenum Press. p. 77-85 as cited in: D. Rudrauf (2003) ‘From autopoesis to neurophenemonology: Francisco Varela’s exploration of the biophysics of being.” In: *Biol Res* 36: 27-65

Humberto Maturana
Francisco Varela

Autopoiesis and cognition: The realization of the living (1980)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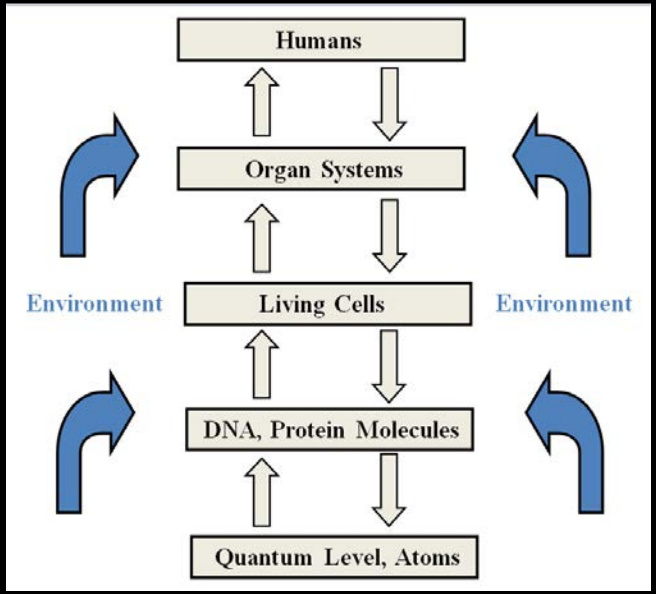
A SPECIAL ISSUE
DEVOTED TO
AUTOPOIESIS

The language of "levels" refers to the concept of "emergence" and "emergent properties."

Birds flocking – an emergent quality called murmuration

Multi-scale levels of life, implying the non-linear nature of causality



Biological Complexity and Integrative Levels of Organization
By: Ingrid Lobo, Ph.D. (*Write Science Right*) © 2008 Nature Education
Citation: Lobo, I. (2008) Biological complexity and integrative levels of organization. *Nature Education* 1(1):141

When units of biological material are put together, the properties of the new material are not always additive, or equal to the sum of the properties of the components. Instead, at each level, new properties and rules emerge that cannot be predicted by observations and full knowledge of the lower levels. Such properties are called emergent properties (Novikoff, 1945). Life itself is an example of an emergent property. For instance, a single-celled bacterium is alive, but if you separate the macromolecules that combined to create the bacterium, these units are not alive. Based on our knowledge of macromolecules, we would not have been able to predict that they could combine to form a living organism, nor could we have predicted all of the characteristics of the resulting bacterium.

The language of “levels” refers to the concept of “emergence” and “emergent properties.”

- From the fractal patterns of snowflakes to cellular lifeforms, our universe is full of complex phenomena – but how does this complexity arise?
- “Emergence” describes the ability of individual components of a large system to work together to give rise to dramatic and diverse behavior.
- Unlike music from an orchestra led by the conductor, emergent behavior arises spontaneously due to (often simple) interactions of the constituent parts with each other and the surrounding environment. Here, there is no “leader” deciding on the behavior of the system.
- Many biological systems commonly exhibit emergent behaviour. The complex behaviour of flocks of birds, colonies of ants, swarms of bees and schools of fish emerges from the interactions of the constituent parts of the respective systems.
- In philosophy, systems theory, science, and art, emergence occurs when an entity is observed to have properties its parts do not have on their own, properties or behaviors which emerge only when the parts interact in a wider whole.
- Emergence plays a central role in theories of integrative levels and of complex systems.
- For instance, the phenomenon of *life* as studied in biology is an emergent property of chemistry, and psychological phenomena emerge from the neurobiological phenomena of living things.
- In philosophy, theories that emphasize emergent properties have been called emergentism.
- Almost all accounts of emergentism include a form of epistemic or ontological irreducibility to the lower levels.*

*sources include Wikipedia, The Conversation, and Psychology Today

Autonomy in Art vs. Autonomy in Biology

BIOTIC ART

Being an artwork means being the product of a historical process of aesthetic coevolution. In other words, *art is a form of communication that coevolves with its own evaluation*. (Prum, 336)

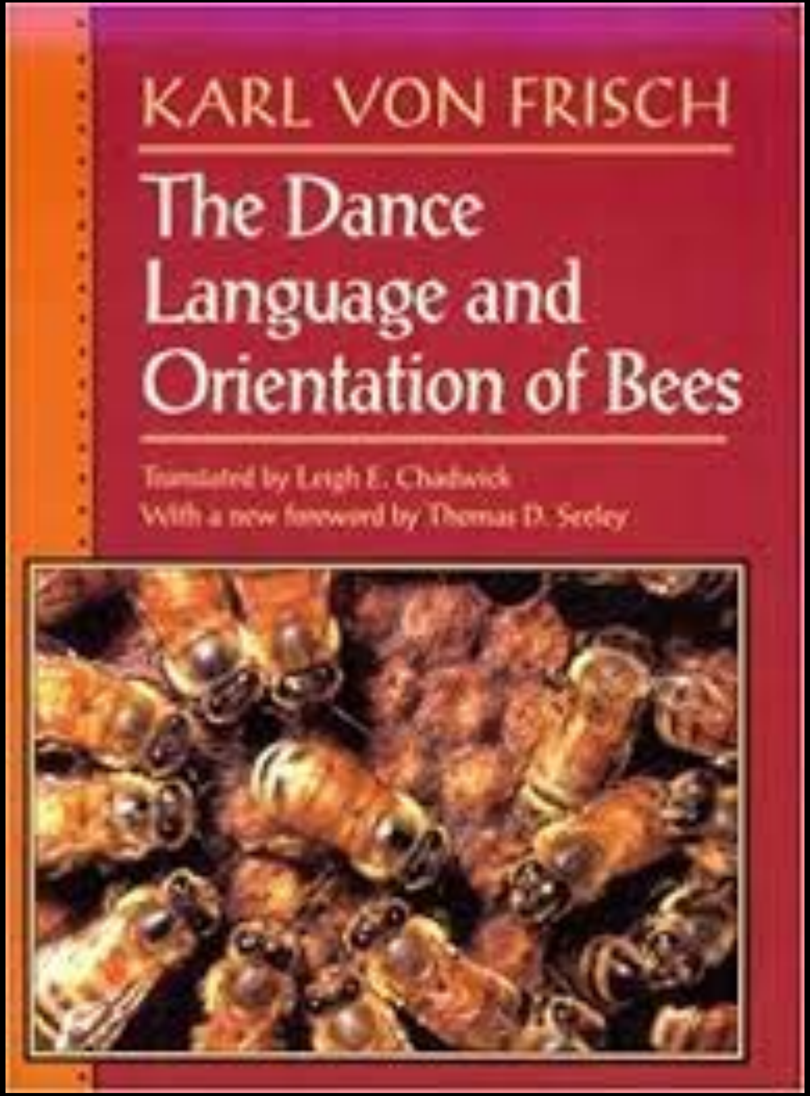
Some aesthetic philosophers, art historians, and artists may find the recognition of myriad new **biotic art** forms to be more of an annoyance, or even an outrage, than a contribution to their fields. But I think there is reason to welcome this more inclusive, "post-human" view of art as a real opportunity for progress in aesthetics…I think that reframing aesthetic philosophy to remove humans from the organizing center of the discipline – to fully encompass the aesthetic productions of both human and nonhuman animals – can only enhance our appreciation of the marvelous diversity, complexity, aesthetic richness, and variable social functions of the human arts. By adopting a post-human aesthetic philosophy that places us, and our artworlds, in context with other animals, we will have a much deeper understanding of how we came to be and what is truly special about being human. (Prum, 337-8)

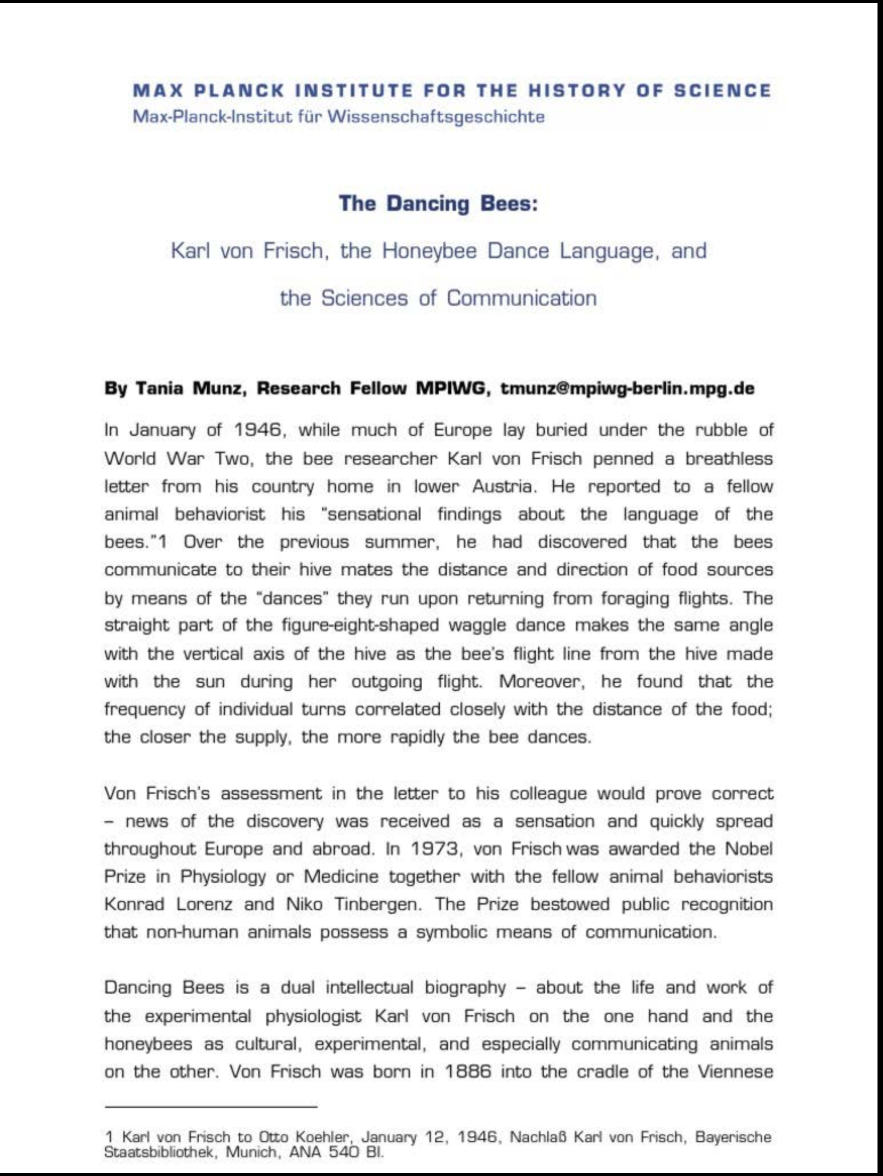
What is "post-human" for Prum?

What more generally is post-humanism?

Hannah – Joe Havel's African grey parrot



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The Dancing Bees:

Karl von Frisch, the Honeybee Dance Language, and the Sciences of Communication

By Tania Munz, Research Fellow MPIWG, tmunz@mpiwg-berlin.mpg.de

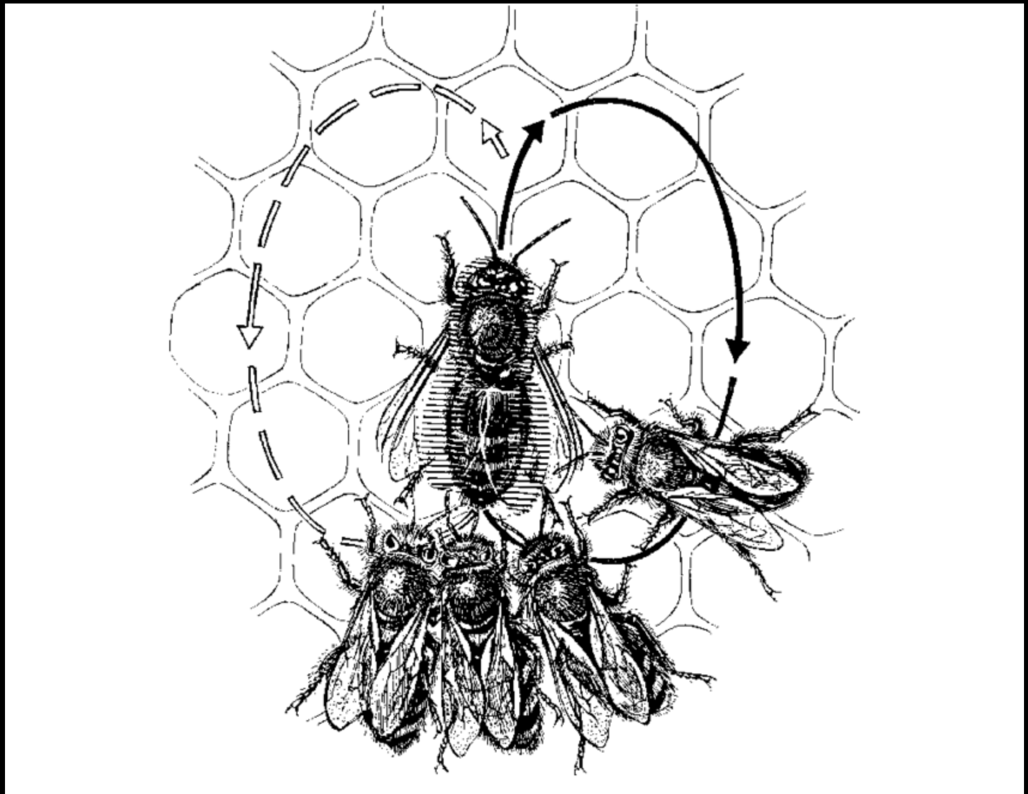
In January of 1946, while much of Europe lay buried under the rubble of World War Two, the bee researcher Karl von Frisch penned a breathless letter from his country home in lower Austria. He reported to a fellow animal behaviorist his "sensational findings about the language of the bees."1 Over the previous summer, he had discovered that the bees communicate to their hive mates the distance and direction of food sources by means of the "dances" they run upon returning from foraging flights. The straight part of the figure-eight-shaped waggle dance makes the same angle with the vertical axis of the hive as the bee's flight line from the hive made with the sun during her outgoing flight. Moreover, he found that the frequency of individual turns correlated closely with the distance of the food; the closer the supply, the more rapidly the bee dances.

Von Frisch's assessment in the letter to his colleague would prove correct – news of the discovery was received as a sensation and quickly spread throughout Europe and abroad. In 1973, von Frisch was awarded the Nobel Prize in Physiology or Medicine together with the fellow animal behaviorists Konrad Lorenz and Niko Tinbergen. The Prize bestowed public recognition that non-human animals possess a symbolic means of communication.

Dancing Bees is a dual intellectual biography – about the life and work of the experimental physiologist Karl von Frisch on the one hand and the honeybees as cultural, experimental, and especially communicating animals on the other. Von Frisch was born in 1886 into the cradle of the Viennese

1 Karl von Frisch to Otto Koehler, January 12, 1946, Nachlaß Karl von Frisch, Bayerische Staatsbibliothek, Munich, ANA 540 Bl.

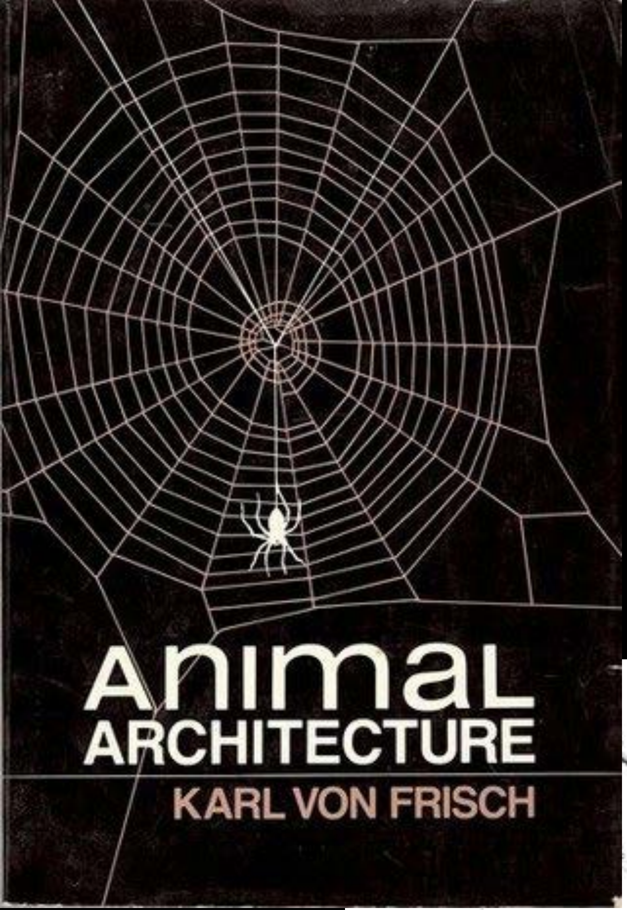
Karl von Frisch won the Nobel Prize for Physiology or Medicine, with Konrad Lorenz and Nikolaas Tinbergen for his achievements in comparative behavioral physiology and pioneering work in communication between insects. (1973)

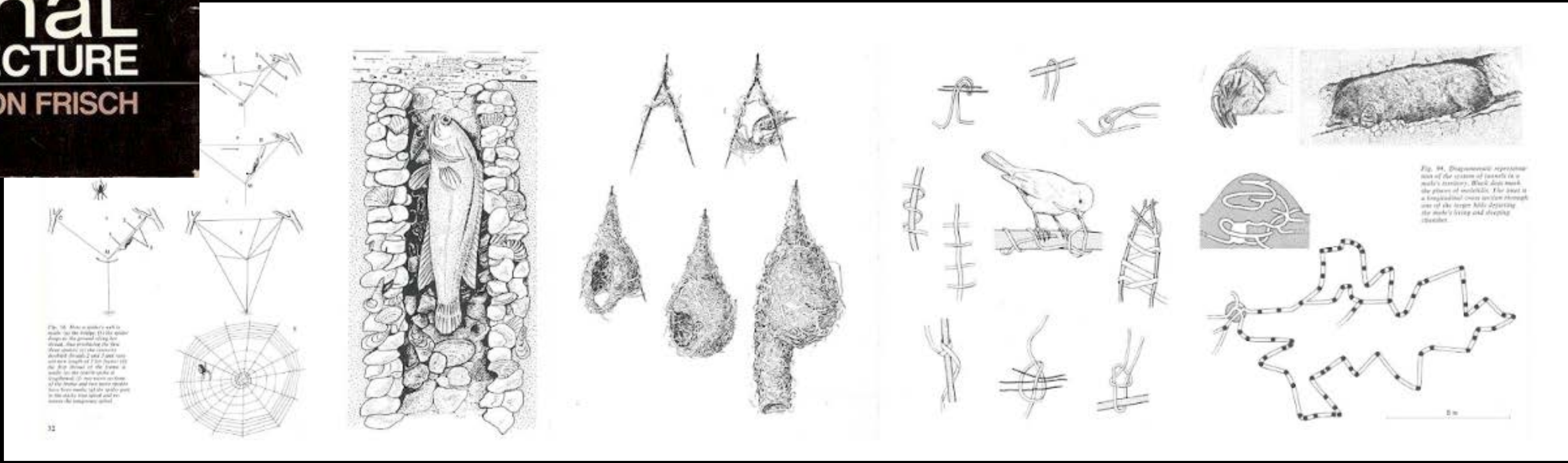


The ”waggle dance" is used to relay information about more distant food sources. In order to do this, the dancing bee moves forward a certain distance on the vertically hanging honeycomb in the hive, then traces a half circle to return to her starting point, whereupon the dance begins again. On the straight stretch, the bee "waggles" with her posterior. The direction of the straight stretch contains the information about the direction of the food source, the angle between the straight stretch and the vertical being precisely the angle which the direction of flight has to the position of the sun. The distance to the food source is relayed by the time taken to traverse the straight stretch, one second indicating a distance of approximately one kilometer (so the speed of the dance is inversely related to the actual distance). The other bees take in the information by keeping in close contact with the dancing bee and reconstructing its movements. They also receive information via their sense of smell about what is to be found at the food source (type of food, pollen, water) as well as its specific characteristics. The orientation functions so well that the bees can find a food source with the help of the waggle dance even if there are hindrances they must detour around like an intervening mountain.

From Wikipedia entry on Karl von Frisch

Illustrations by Turid Hölldobler





When we stand before great churches, temples, pyramids, and other works of architecture built hundreds, if not thousands, of years ago, our minds are filled with awe and admiration. Yet there have been architects millions of years before that. Their work, it is true, owes its existence not to the inspired genius of great artists, but to the unconscious, unremitting activity of the force of life itself. Without tools, indeed without anything that could be called action, the coral polyps of the warm seas erected their limestone piles—edifices that can reach the size of mighty mountains—and they go on building today. Certain microscopic organisms, the Radiolaria, have been producing glasslike supporting structures for their tiny delicate bodies for even longer periods. Living dispersed as they do over the vastness of the oceans, they do not build up imposing monuments out of their siliceous skeletons; but many an artist's eye has been transported by the contemplation of their exquisite beauty. To such organisms we shall briefly turn our attention.

But mainly this book will be devoted to the activities of animals that actually build structures of the greatest diversity from extraneous materials or from substances they produce within their bodies—using techniques akin to those that humans employ in masonry, weaving, plaiting, digging, and so on. Some of these structures serve as traps for prey, but most of them are intended as protection for the animal's own body or for its young. Nature has provided these builders with the tools of their trade: they use their teeth, their beaks, their legs, and other parts of their bodies. In many cases these organs are amazingly well adapted to the special tasks they have to perform.

THE LIVING BODY AS ARCHITECT–EXTERIOR AND INTERIOR DESIGNS

THE MICROSCOPIC SPHERE

At the bottom of the animal kingdom we place the unicellular animalcules, the protozoa. As a rule they are so small that they are invisible to the naked eye, or nearly so. One of the most primitive among them is the amoeba, an inhabitant of fresh-water puddles. Its body consists of a little blob of protoplasm and a nucleus. However, even the organization of amoebae is not quite so simple as previously had been assumed. The electron microscope has revealed that many elements of structure in the protoplasm and the nuclei of unicellular animals are not very different from corresponding formations in the cells of higher animals. In comparison with these, of course, the organization of amoebae is very primitive. The amoeba can move along the leaf surface of an aquatic plant—or any other surface—in any direction by allowing its protoplasm to flow in that direction, extending so-called pseudopodia (Greek for "apparent legs") and retracting similar pseudopodia from another direction (fig. 1). An

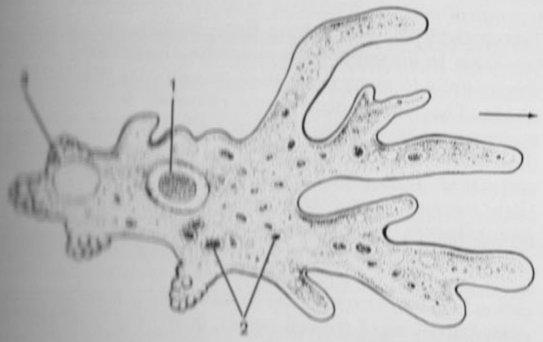
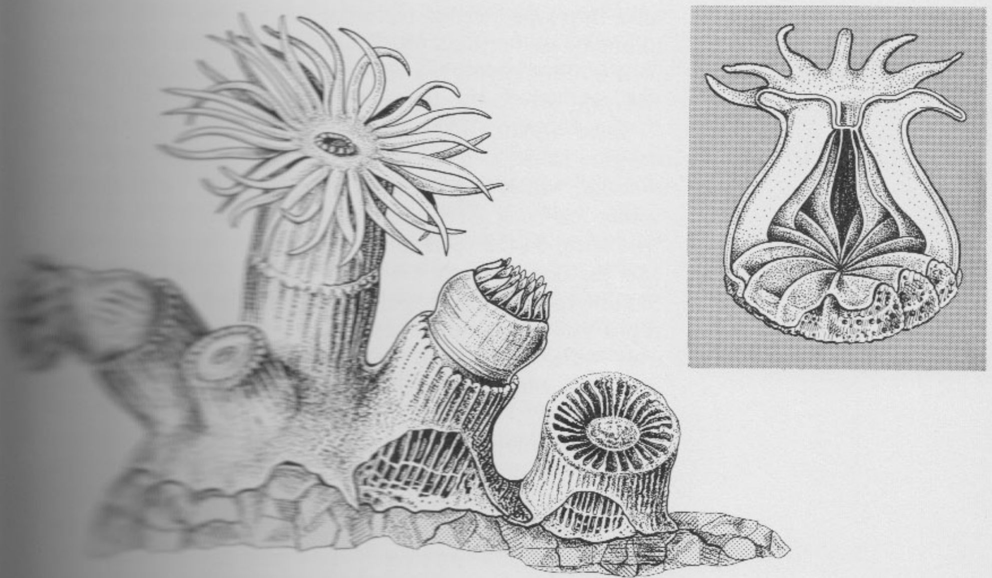


Fig. 1. Amoeba (Amoeba pro
crawling in direction of arrow
(1) Cell nucleus; (2) food resid
(3) contractile vacuole whose rhythmic contractions pump o the water which constantly per ates the organism. Size in the longitudinal direction, ½ mm. good light, amoeba may be visi to the naked eye as a minute w speck.



colonies. Their shapes may vary considerably because the manner of dividing, or "budding," differs between species. Some coral structures are tightly branched, others are loosely branched; some form round blocks, others form shapes resembling disks, or candelabra. Plate III (p. 19) gives an idea of this variety. It shows a small part of a coral reef as it emerges at low tide. The polyps have retracted completely and have covered their skeletons, as if with delicate skins. By secreting a mass of mucous substance, they protect themselves from dehydration and can withstand several hours' exposure to the air without suffering any injury. As soon as the water returns, they will stretch themselves once

Fig. 7. A small section of a colony of coral polyps. One polyp expanded; two partly expanded; one wholly contracted; below, right, a skeleton after removal of soft tissue. Diameter of the pediment is about 8 mm. Top right, diagrammatic cross section of single polyp slightly magnified. The ribbed foot secretes lime on its underside, thereby forming pediment on which the polyp rests.

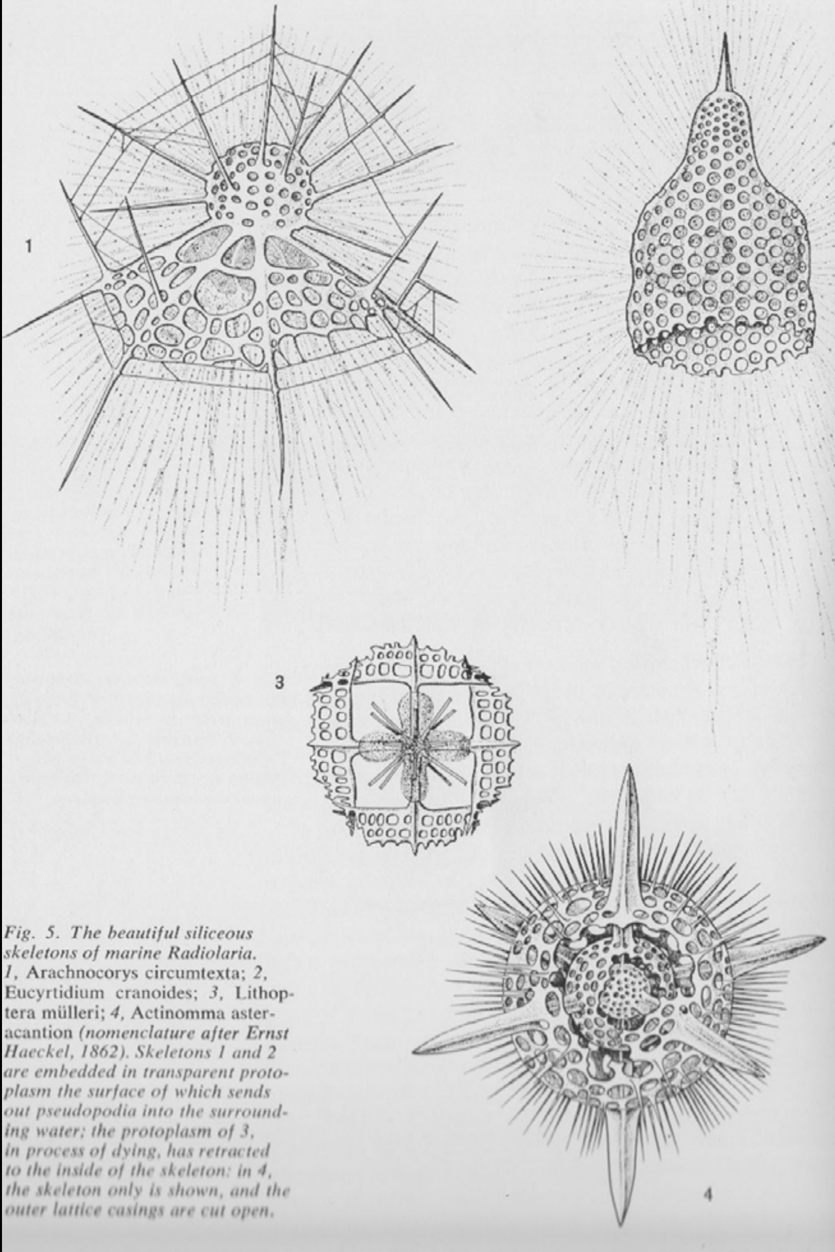
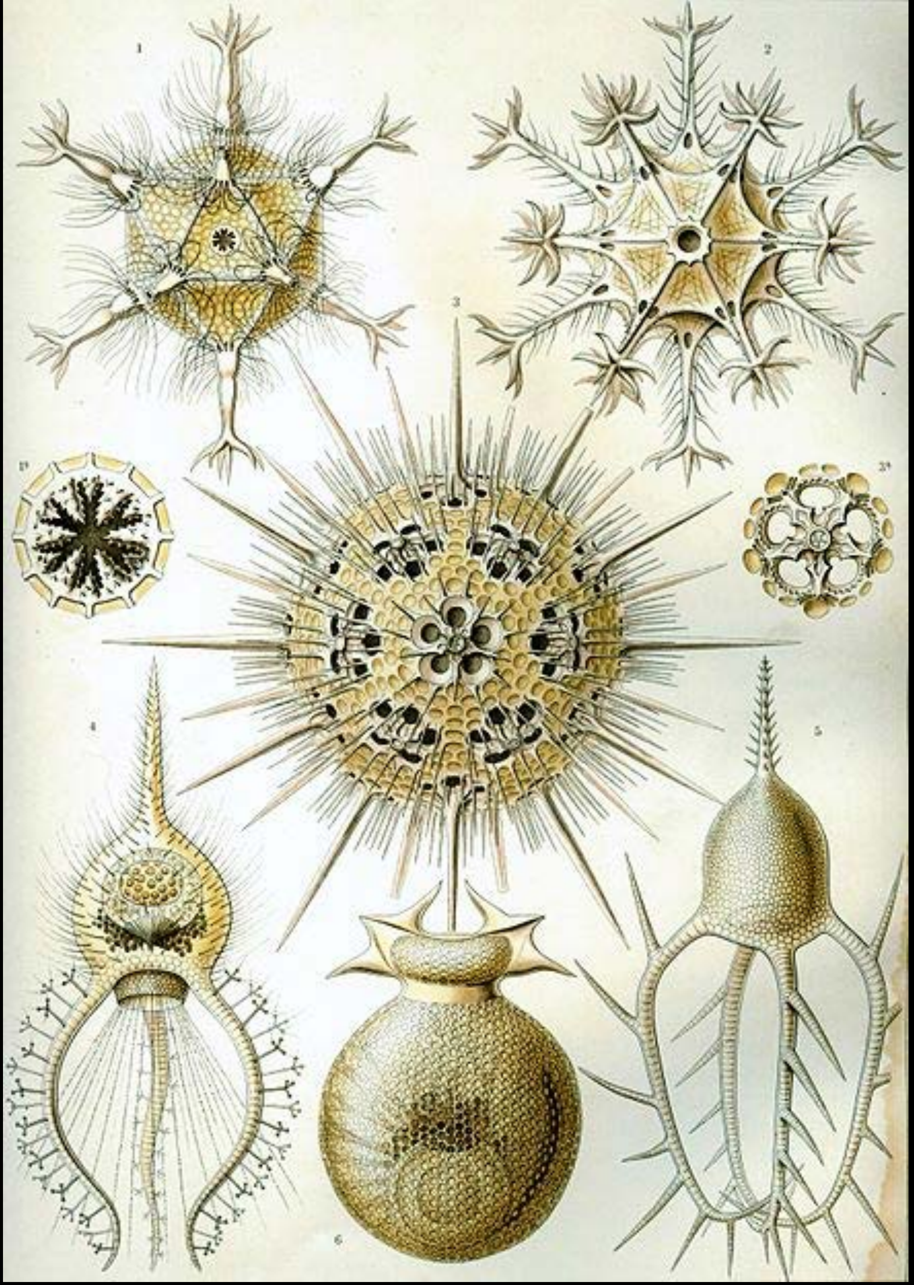
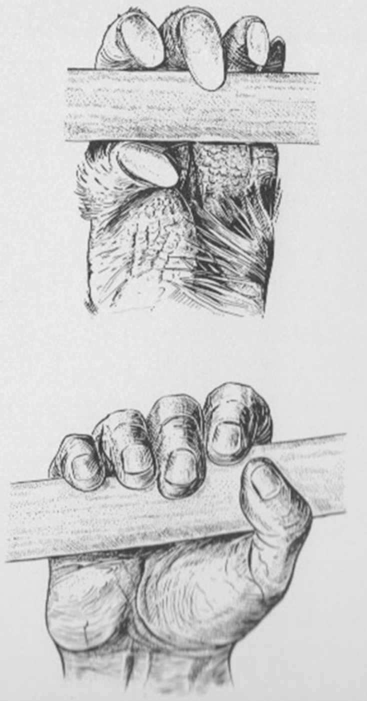


Fig. 5. The beautiful siliceous skeletons of marine Radiolaria. 1, Arachnocorys circumtexta; *2,* Eucyrtidium cranoides; *3,* Lithoptera mülleri; *4,* Actinomma asteracantion *(nomenclature after Ernst Haeckel, 1862). Skeletons 1 and 2 are embedded in transparent protoplasm the surface of which sends out pseudopodia into the surrounding water; the protoplasm of 3, in process of dying, has retracted to the inside of the skeleton: in 4, the skeleton only is shown, and the outer lattice casings are cut open.*



"Phaeodaria" from Ernst Haeckel's *Kunstformen der Natur,* 1904

Fig. 103. A beaver's hand and a human hand. The beaver's thumb is poorly developed; the little finger has taken over the role of our thumb.



Apes

Of all living animals the chimpanzees are closest to man. This holds true whether one bases one's assessment on their anatomy, their physiology, or their mental capacity. A visitor to the zoo feels strangely fascinated by them. He discovers traits akin to his own in each facial grimace, in each expressive movement, and in their entire behavior. However, most zoo animals were born in captivity and grew up with humans. May they not have learned to "ape" us?

In recent years chimpanzees and other apes have been studied very thoroughly in the field. In some respects the wild animals appear even more human than those in the zoo. Some fascinating new insights have been gained into their habits and family life, but no remarkable building activities have come to light. Their building consists merely in the construction of simple nests for sleeping. We owe much detailed information on their building habits and other behavior to a young Englishwoman, Jane Goodall (now Mrs. van Lawick-Goodall), whose findings have been published in *In the Shadow of Man* (Boston and London, 1971). For ten years she studied the apes in the Gombe Stream Chimpanzee Reserve (now a national park) close to Lake Tanganyika in central Africa, where these animals are protected and allowed to live in peace. In the beginning, her patience was put to a severe test. The apes were shy and refused to let her get a glimpse of their lives through the curtain of forest leaves. But gradually they got used to her unobtrusive presence and tolerated her near them without letting her presence affect their behavior. Admittedly, it took her over a year to reach this stage.

Except for infants, each individual chimpanzee builds

some of the nests after the chimpanzees ...
In some of the nests she found evidence of quite compli-

Fig. 104. A chimpanzee in its sleeping nest.

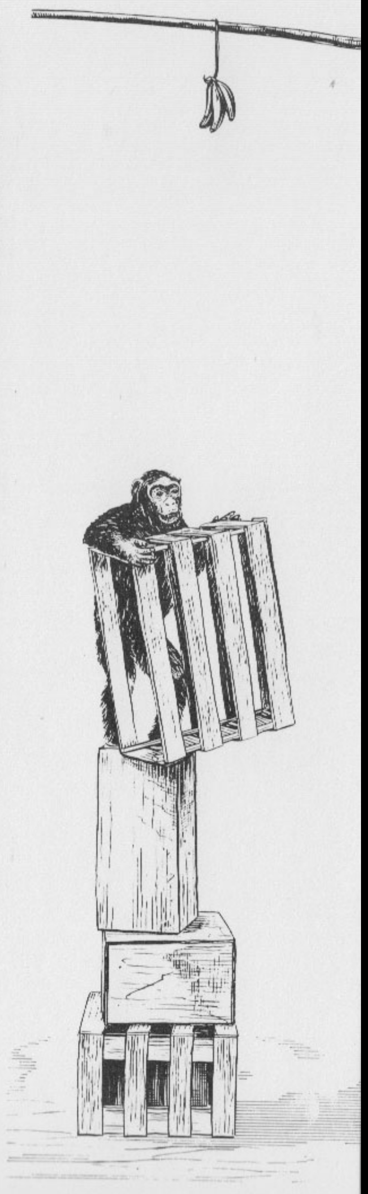
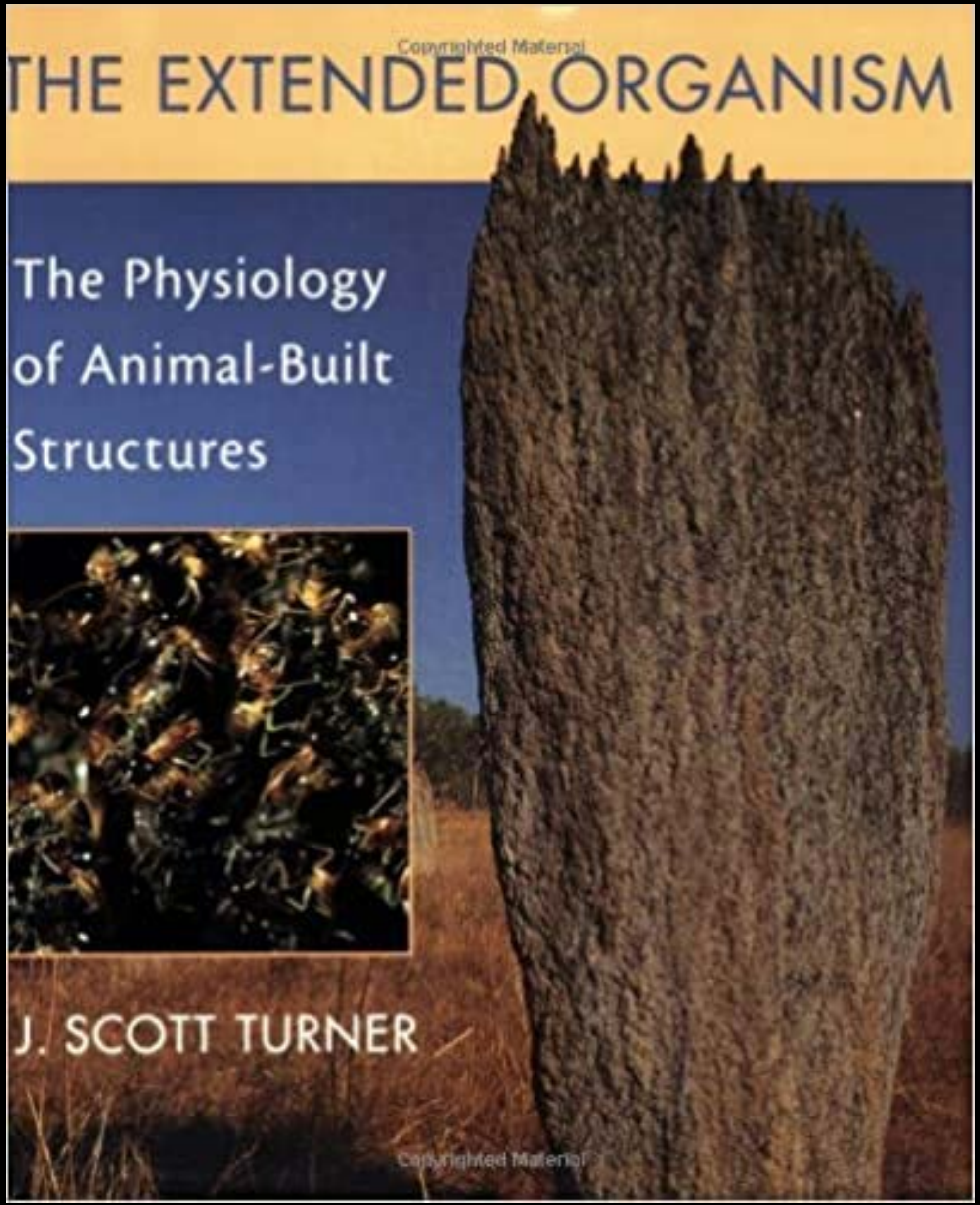


Fig. 105. A chimpanzee builds a tower from packing cases in order to reach fruit hung beyond his reach.



- Can the structures that animals build -- form the humble burrows of earthworms to towering termite mounds to the Great Barrier Reef – be said to be live?
- Many animals construct and use structures to harness and control the flow of energy from their environment to their own advantage.
- Building on Richard Dawkin's The Extended Phenotype, Turner shows why drawing the boundary of an organism's physiology at the skin is arbitrary.
- Since the structures animals build undoubtedly do physiological work, capturing and channeling chemical and physical energy, Turner argues that such structures are more properly regarded not as frozen behaviors but as external organs of physiology and even extensions of the animal's phenotype.

Superorganism: A mound built by cathedral termites
A superorganism is a group of synergetically interacting organisms of the same species. A community of synergetically interacting organisms of different species is called a holobiont.

- The organism's fuzzy boundaries
- An evolutionary biologist sees the extended phenotype as the extension of the action of genes beyond the outermost boundaries of an organism and asks how these extended phenotypes aid in the transmission of genes from one generation to the next.
- A physiologist, however, sees the extended phenotype in terms of mechanism and ask how it works, how it alters the flows of matter, energy, and information through the organism and between the organism and its environment.
- In organisms we recognize individuality, intention, purposefulness, function, and *beingness*.
- Reductive Darwinism has come to view life as a mechanism, as a special case of chemistry, physics, and thermodynamics.
- Organism from this reductionist perspective = molecular machine
- Author J. Scott Turner sees the organism otherwise: as woven into its environment.
- It is not the boundary itself that makes an organism distinctive, but what the boundary *does*.
- In other words, the boundary is not a thing, it is a *process*, conferring upon the organism a persistence that endures as long as its boundary can adaptively modify the flows of energy and matter through it.