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# The Intertwined Worlds of Zebra and Lion

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*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*<sup>1</sup>). 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.<sup>2</sup> 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.<sup>3</sup>

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.<sup>4</sup> 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.<sup>5</sup>

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.<sup>6</sup> 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.<sup>7</sup> 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.<sup>8</sup>

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.”<sup>9</sup>

The plains zebra lives in groups with usually one stallion, a number of mares, and their offspring; the mares are not necessarily related.<sup>10</sup> 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.<sup>11</sup> 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.”<sup>12</sup> 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.”<sup>13</sup>

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.<sup>14</sup> 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.<sup>15</sup>

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.<sup>16</sup> 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.<sup>17</sup> 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.<sup>18</sup>

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.<sup>19</sup> 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.<sup>20</sup>

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.<sup>21</sup>

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.<sup>22</sup> 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.

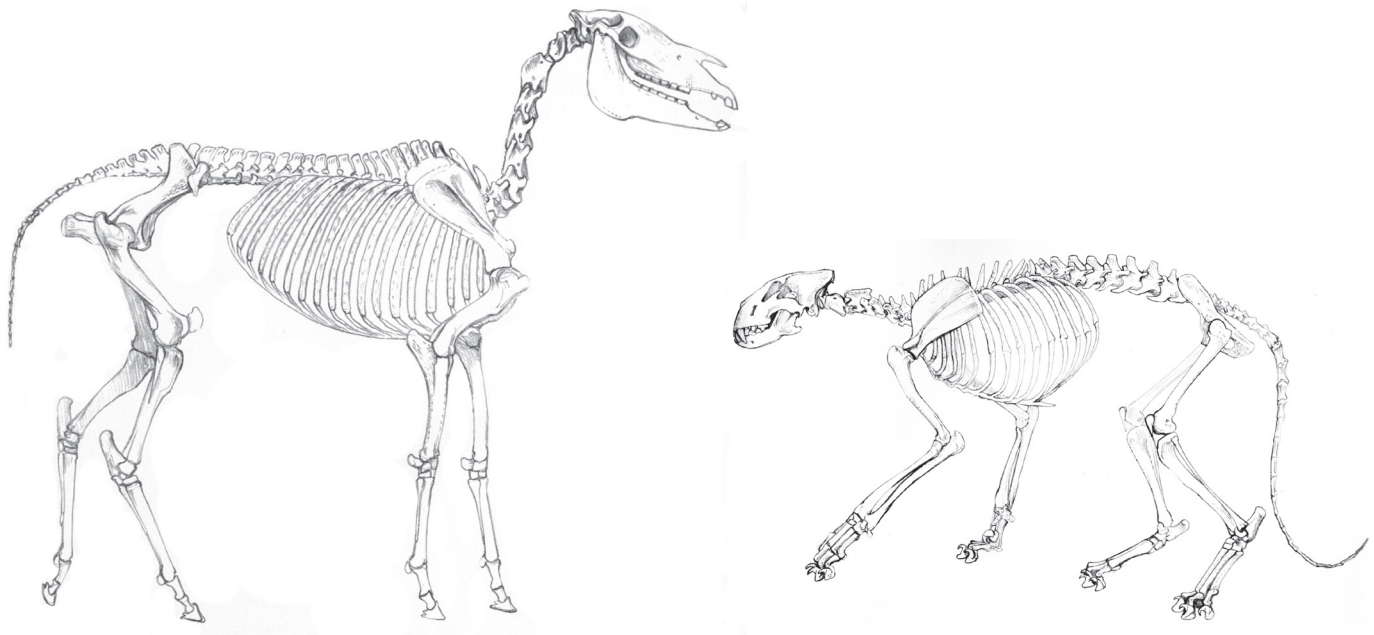


Figure 3. Zebra and lion skeletons. (Adapted from Kingdon 1977, vol. IIIa, p. 393 and Kingdon 1979, vol. IIIB, p. 144)

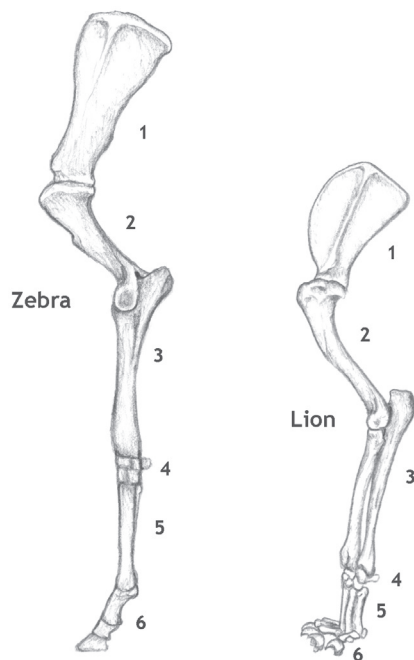


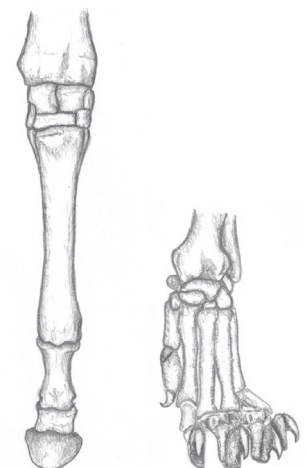
Figure 4. Forelimb of zebra and lion. 1: scapula; 2: humerus; 3: ulna and radius (in zebra fused together); 4: carpals; 5: metacarpals; 6: phalanges (toe bones).

This structure of bone, ligaments, and tendons provides stability, so that the zebra can stand with virtually no muscular effort.<sup>23</sup> 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.<sup>24</sup> 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.”



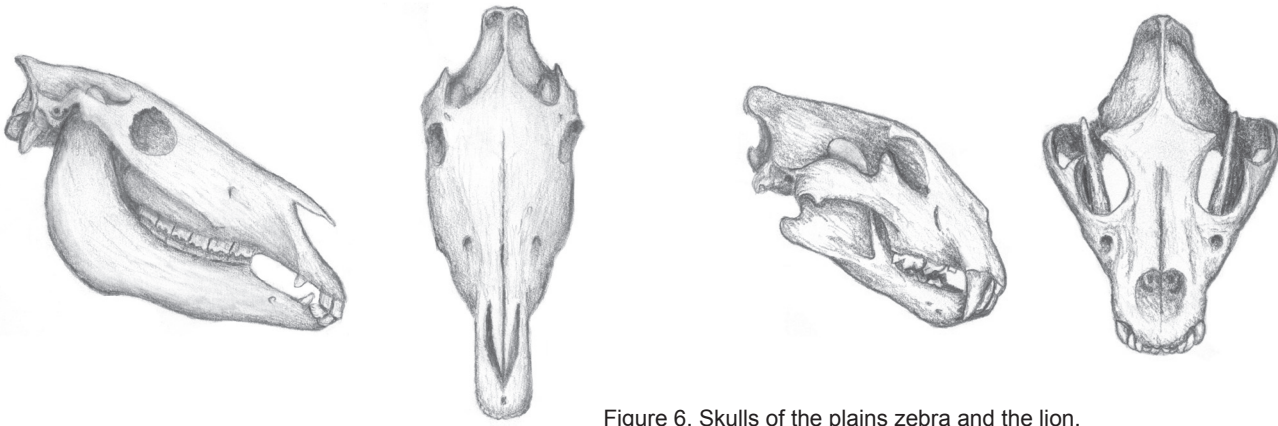


Figure 6. Skulls of the plains zebra and the lion.

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, thunder-

ous roars,<sup>25</sup> and finally a series of grunts. This whole sequence can last up to a minute.<sup>26</sup> 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.

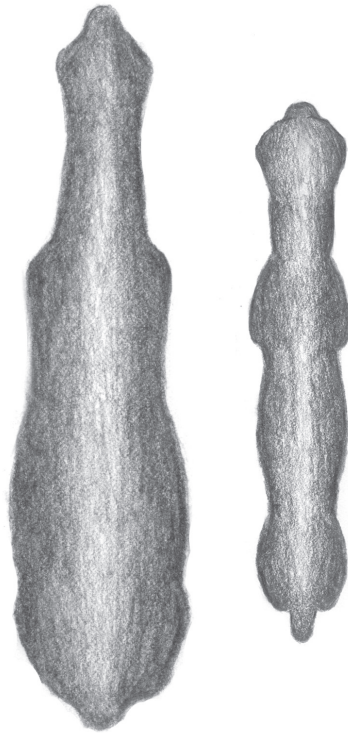


Figure 7. Overhead silhouettes of zebra and lion.

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, 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.<sup>27</sup>



## NOTES

- 1 Groves and Bell 2004
- 2 Estes 1991, p. 236
- 3 McNaughton 1985
- 4 Estes 1991, Sanson 2006
- 5 Brooks and Harris 2008
- 6 Bell 1971
- 7 Naidoo et al. 2016
- 8 Moss 1982, pp. 99 f. and 105
- 9 Estes, 1991, p. 237
- 10 Klingel 1969 and 1972.
- 11 Hayward and Slotow 2009; Schaller 1972
- 12 Moss 1982, p. 255
- 13 Lindbergh 1966
- 14 Mosser and Packer 2009
- 15 Schaller 1972, p. 157
- 16 Hayward and Kerley 2005; Sinclair et al. 2003
- 17 On lion hunting: Fischhoff et al. 2007; Haas, 2005 (has many references); Sinclair et al. 2003; Funston et al. 2001; Funston et al. 1998; Elliott et al. 1977; Schaller 1972
- 18 Schaller 1972, p. 268
- 19 Klingel 1966; Wackernagel 1965
- 20 Estes 1991, p. 376
- 21 Smuts 1975
- 22 Budiansky 1997, Gray 1968
- 23 Nickel et al. 1986
- 24 Budiansky 1997; Hildebrand 1974
- 25 Estes 1991, p. 374
- 26 Pfefferle et al. 2007
- 27 Holdrege 2017

## REFERENCES

- Bell, Richard (1971). A Grazing Ecosystem in the Serengeti, *Scientific American* vol. 225(1), pp. 86–93. doi: 10.1038/scientificamerican0771-86. Brooks, C. J. and Stephen Harris (2008). Directed Movement and Orientation Across a Large Natural Landscape by Zebras (*Equus burchelli antiquorum*), *Animal Behaviour* vol. 76, pp. 277–85. doi: 10.1016/j.anbehav.2008.02.005.
- Budiansky, Stephen (1997). *The Nature of Horses*. New York: The Free Press.
- Elliott, John P. et al. (1977). Prey Capture by the African Lion, *Canadian Journal of Zoology* vol. 55(11), pp. 1811–28. doi: 10.1139/z77-235.
- Estes, Richard D. (1991). *The Behavior Guide to African Mammals*. Berkeley, CA: University of California Press.
- Fischhoff, Ilya R. et al. (2007). Habitat Use and Movements of Plains Zebra (*Equus burchelli*) in Response to Predation Danger from Lions, *Behavioral Ecology* vol. 18(4), pp. 725–9. doi: 10.1093/beheco/arm036.
- Funston, P. J. et al. (1998). Hunting by Male Lions: Ecological Influences and Socioecological Implications, *Animal Behaviour* vol. 56, pp. 1333–45. doi:10.1006/anbe.1998.0884.
- Gray, James (1968). *Animal Locomotion*. New York: W. W. Norton & Company.
- Groves, Colin P. and C. Bell (2004). New Investigations on the Taxonomy of the Zebras genus *Equus*, subgenus *Hippotigris*, *Mammalian Biology* vol. 69(3), pp. 182–96. doi: 10.1078/1616-5047-00133.
- Haas, Sarah K. et al. (2005). *Panthera leo*, *Mammalian Species* vol. 762, pp. 1–11. doi: 10.1644/1545-1410(2005)762[0001:PL]2.0.CO;2.
- Hayward, Matt W. and G. Kerley (2005). Prey Preferences of the Lion (*Panthera leo*), *Journal of Zoology* vol. 267, pp. 309–22. doi: 10.1017/S0952836905007508.
- Hayward, Matt W. and R. Slotow (2009). Temporal Partitioning of Activity in Large African Carnivores: Tests of Multiple Hypotheses, *South African Journal of Wildlife Research* vol. 39, pp. 109–25. doi: 10.3957/056.039.0207.
- Hildebrand, Milton (1974). *Analysis of Vertebrate Structure*. New York: John Wiley & Sons.
- Holdrege, Craig (2017). Why Do Zebras Have Stripes? (Maybe it's the Wrong Question). *In Context* #9, pp. 17–23.
- Klingel, Hans and Uta Klingel (1966). Die Geburt eines Zebras (*Equus quagga böhmi Matschie*), *Zeitschrift für Tierpsychologie* vol. 23, pp. 72–6.
- Klingel, Hans (1969). The Social Organisation and Population Ecology of the Plains Zebra (*Equus quagga*), *Zoologica Africana* vol. 4, pp. 249–63. doi: 10.1080/00445096.1969.11447374.
- Klingel, Hans (1972). Das Verhalten der Pferde (*Equidae*), *Handbuch der Zoologie* vol. 10(24), pp. 1–68.
- Lindberg, Ann Morrow (1966). Immersion in Life: Journey to East Africa, *Life* vol 61(17), pp. 89–99.
- McNaughton, S. J. (1985). Ecology of a Grazing Ecosystem: The Serengeti, *Ecological Monographs* vol. 55(3), pp. 259–94. doi: 10.2307/1942578.
- Moss, Cynthia (1982). *Portraits in the Wild* (2nd edition). Chicago: University of Chicago Press.
14. Mosser, Anna and Craig Packer (2009). Group Territoriality and the Benefits of Sociality in the African Lion, *Panthera leo*, *Animal Behavior* vol. 78, pp. 359–70.
- Naidoo, R. et al. (2016). A Newly Discovered Wildlife Migration in Namibia and Botswana Is the Longest in Africa, *Oryx* vol. 50, pp. 138–46. doi: 10.1017/S003060531400022.
- Nickel, Richard et al. (1986). *The Anatomy of the Domestic Animals. Vol. 1, The Locomotor System of the Domestic Mammals*. Berlin: Verlag Paul Parey.
- Pfefferle, Dana et al. (2007). Do Acoustic Features of Lion, Panthera leo, Roars Reflect Sex and Male Condition? *The Journal of the Acoustical Society of America* vol. 121, pp. 3947–53.
- Sanson, Gordon (2006). The Biomechanics of Browsing and Grazing, *American Journal of Botany* vol. 93(10), pp. 1531–45.
- Schaller, George (1972). *The Serengeti Lion*. Chicago: University of Chicago Press.
- Sinclair, A. R. E. et al. (2003). Patterns of Predation in a Diverse Predator-prey System, *Nature* vol. 425, pp. 288–90. doi: 10.1038/nature01934.
- Smuts, G. L. (1975). Pre- and Postnatal Growth Phenomena of Burchell's Zebra (*Equus burchelli antiquorum*), *Koedoe* vol. 18(1), pp. 69–102. doi: 10.4102/koedoe.v18i1.915.
- Wackernagel, Hans (1965). Grant's Zebra (*Equus burchelli boehmi*) at Basle Zoo – A Contribution to Breeding Biology, *International Zoo Yearbook* vol. 5, pp. 38–41. doi: 10.1111/j.1748-1090.1965.tb01567.x.