

# Out of the Life of the Dairy Cow

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Photo: C. Holdrege

A grazing dairy cow from Hawthorne Valley Farm, Ghent, New York.

*This article is a short, edited excerpt from the beginning of a much longer chapter on the dairy cow for a book on animals that Craig is writing.*

AS A DOMESTICATED ANIMAL, the dairy cow's past, present, and future — down into the core of its biological make-up — are directly and inextricably connected with human activity. Through thousands of years of interchange, we have become part of the cow's being, and she part of ours, in a way that goes beyond the connection we have with wild animals. Cows are deeply dependent on us and we on them.

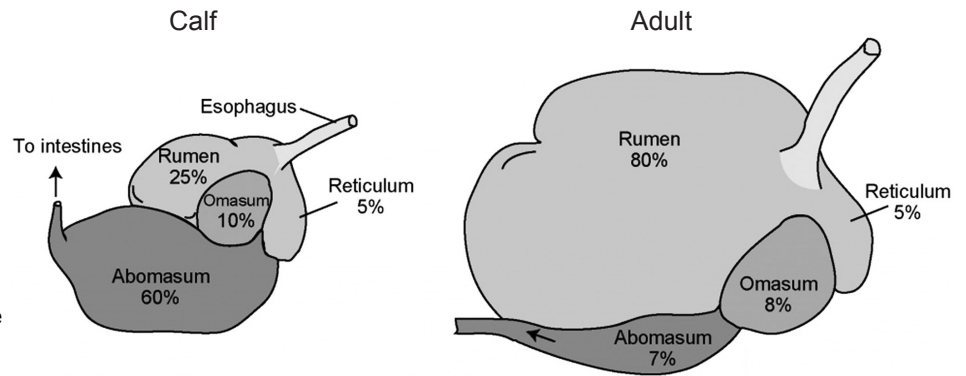
This bond makes the question of what responsibility we have to cows (and to all domesticated animals) loom large. How do we view this relationship and how does that view guide our intentions in the way we breed and treat these animals? Do we see cows as beings who serve us and for whom we respectfully care? Do we see them as units of production whose efficiency we need to maximize? Do we manipulate them as bioreactors to produce substances we desire? You can find all of these perspectives expressed today and they all have consequences.

It is clear that, when in industrial agriculture, cows are viewed as production units, they are being considered

primarily from the perspective of economic profit. Such a perspective avoids considering much of the reality of the animal's life and the way it is woven into the larger world. When we begin to turn our attention toward that larger fabric, we learn how the cow is a truly integrated organism with a very specific way of being. How can we interact with this animal responsibly without at least some understanding of its unique way of being in the world? What follows is a glimpse into some of the dairy cow's salient features.

Cows are grazers. If they are allowed to lead a life that corresponds to their nature, they live on pastures — in the midst of the food they eat — grazing on grasses and wildflowers. The cow lowers her head to the ground and touches the plants with the front end of her soft, moist snout. She does not chomp off the plants with her teeth. In fact, the cow (like the bison, giraffe, and other ruminants) has no top incisors or canines. She has, instead, a tough fibrous dental pad at the front of the hard palate. When feeding, the cow reaches out with her rough, muscular tongue, envelops the plants, and tears them off while slightly throwing her head upward and to the side. She clearly needs to use her tongue for feeding — cattle that receive soft, fiber-poor

A schematic drawing of the development of the cow's four-chambered stomach. Only after a calf has begun feeding on grass, does the rumen develop fully in size and function.



feed begin to lick their fellow cows much more than usual to compensate for the lack of interaction with the tough, fibrous grasses and forbs. The cow needs this interaction to remain healthy.

Taking about one bite per second, the cow moves slowly through the pasture. Large glands secrete saliva while she grazes, and after taking many bites, she swallows the now moistened mass of food. She can continue grazing in a kind of flowing rhythmic persistence for a couple of hours at a time. Cows on the pasture have several such feeding periods during the 24-hour day, spending about one-third of the total day grazing. When swallowed, the food reaches the rumen, the huge first chamber of the four-chambered stomach. Occupying the entire left side of the abdominal cavity, the rumen can hold up to forty-five gallons of fluid and feed. The muscular rumen massages the food in regular contractions — about one to two per minute is a sign of a healthy cow. It is only when a calf

begins to feed on grass that the rumen completes its development and becomes fully functional. You could say that grass is the environmental half of the rumen, and that the cow's anatomy and physiology only become whole through the activities of feeding and digestion.

In the rumen, forage churns around in the fluid of the saliva and any water that the cow has drunk. The rumen itself does not secrete digestive juices. When it is about half-full, a wad of partially digested forage (what we call the cud) is, via the second chamber of the stomach (the reticulum), regurgitated back into the mouth. If you are watching, you can see a bulge rapidly course up the cow's neck. When the cud reaches the mouth, the cow begins to ruminate. She grinds the food between her large cheek teeth in rhythmical, circling motions of the lower jaw. She chews a cud about 50 to 60 times before swallowing it. Soon thereafter a next cud travels up the throat and rumination continues. The saliva glands secrete copious amounts of saliva while the cow is



Photo: C. Holdrege

Dairy cows ruminating at Hawthorne Valley Farm, Ghent, New York.





Photo: C. Holdrege

Part of Hawthorne Valley Farm's dairy herd. Note the bull and a couple of calves in the foreground. A herd is only complete with cows, calves, and a bull.

feeding and ruminating — up to fifty gallons a day. Yes, that's right: fifty gallons. The drier the feed (for example, hay), the more saliva a cow secretes, and the greater the amount of water she drinks.

Cows usually lie on the ground while ruminating, often with drooping or fully closed eyelids. If you are ever in a hectic state of mind and find yourself driving through the countryside and have the luck to spot a herd of cattle lying on the ground — I know, not too likely a scenario — stop and spend a half hour attending to the herd. Expand out into it. You'll calm down. As they lie quietly in the pasture, their activity focused inward on grinding and digestion, the cows radiate centeredness and quietude. For the total of eight or so hours of rumination per day, it is as though the mixing, breaking down, exchanging, and building up of substances is telling the cow an intricate and enchanting story that she is intently listening to.

As with bison and other ruminants, digestion in the rumen is facilitated by microorganisms that break down cellulose, the main, hard-to-digest component of fresh forage and hay. The forage is churned around, and it takes a few days for it to fragment into ever smaller particles and to be broken down biochemically by the microorganisms. During this process nutritious fatty acids are released and absorbed through the rumen wall into the bloodstream. Since saliva is alkaline, it serves as a buffer and prevents the environment of the rumen from becoming too acidic. In an acidic environment, the microorganisms could not thrive.

Digestion is such a central part of the ruminant's life that even the animal's head plays a major role in breaking down the forage through about 40,000 grinding motions a day, copious salivation, and thorough chewing of the cud. As biologist E. M. Kranich suggests, you can consider the cow's mouth functionally as a fifth chamber of the stomach. After the mouth, digestion then continues in the microbial realm of the rumen. From there, the partially digested food moves into the other three chambers of the stomach that continue the process of transformation. Only the last chamber, the abomasum, is comparable to our stomach. It secretes hydrochloric acid that kills bacteria, and digestive juices that break down proteins. As if the mouth and four stomach chambers had not done enough, digestion continues in the approximately 130 feet (40 meters) long coils of the small intestine. (That's about twenty times the length of the animal!) After the cow has broken down the substances as far as possible and absorbed the many nutrients into the bloodstream, the large amounts of fluid that have been secreted as saliva and digestive juices are also reabsorbed, mainly in the last part of the digestive tract — the large intestine.

What has been digested and reabsorbed in the gastrointestinal tract then enters the blood. The blood has the unique feature of being a fluid organ that connects all organs of the body by flowing through them. It gives over substances to the organs and receives substances from them. We need to imagine the blood as changing

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at every moment along its pathway. In every part of the body the blood is distinct inasmuch as it is responding to what comes from the organs and what they need. And yet in all this transformation, it remains a coherent flowing organ. Through this mediating activity of the blood, what the process of digestion brings forth allows the animal to continually re-create itself.

But that is not all. Through digestion, substances arise that the cow does not incorporate into her own organism, but rather gives off into the larger world. At the front end, she exhales with every breath — as all animals do — moist, warm air that is richer in carbon dioxide than the air she inhaled. And cows also burp frequently. In the process they give off methane-rich air that has arisen through ruminal fermentation. At the back end, she releases large amounts of manure — urine and dung — into the environment. A dairy cow weighing about one thousand pounds will excrete a total of eighty pounds of manure per day.

Manure is a key element in building soil fertility. On the one hand, cows leave urine and feces on the pasture. And on the other hand, on dairy farms that are sustainably managed, manure collected in the barns is mixed with straw and other plant matter, is then composted, and finally spread on the fields. In this way the cow is an essential contributor to the fertility of the soil, helping plants to thrive that in turn serve the cows.

In contrast to the solid dung of other ruminants like sheep or goats, cows have fluid dung. The cow's large intestine does not absorb as much water out of what has been digested. In fact, we could say that from her moist snout, through all the secretions in her digestive tract, and finally in her dung, the cow embodies fluidity more than other ruminants — in a sense a paradox for such a large, heavy-boned, and stout animal. The solid bones support a massive body. And in the blood and the voluminous inner spaces of the digestive organs, continual and intense transformation occurs in the medium of fluids.

A most special fluid gift that the cow creates is milk. It provides just that nourishment her offspring need. And through domestication and husbandry, she creates more milk that we use for our consumption. Fill a glass with milk and place next to it a glass with grass in it. Two wholly different substances. The cow transforms the dry, fibrous grass

into a nutritious, creamy fluid. This demands intense activity on the part of the whole physiology of the cow. Breaking down and digesting grass already places high demands on the body. For example, for every quart of saliva the cow creates, three hundred quarts of blood pass through the salivary glands. The other digestive organs are sustained by a similarly strong circulation.

The intense transformation of substances and secretion of fluids characterizing the digestive process are heightened in the formation and secretion of milk. For every quart of milk, three hundred to five hundred quarts of blood pass through the udder. The udder receives from the blood — and that means from the rest of the whole animal — the substances it needs for its mammary glands to create milk. Fine membranes separate blood and mammary glands. On the one side flows nutrient-rich blood, giving over proteins, water, fats, and carbohydrates to the mammary glands. And on the other side of the membranes, the glands fashion and secrete a creamy white fluid. It is hard not to be in awe of the cow's ability to transform substances in its quiet and steady way.

For modern consumers, milk is a packaged good that we find in the refrigerated section of a store. Most people will know that this milk comes from cows, but many children growing up in an urban environment never will have seen a cow. Most people probably don't know what kind of dairy farm the milk came from, or how the animals were fed and treated. If, by circumstance or study, we do know something about these things, then we have begun at least in our minds to free the milk from its status as an isolated product for consumption.

We can see it instead as an expression of a whole nexus of processes. The generation of milk stands as the special result of the cow's interaction with pasture, soil, sun, and weather— and, of course, with her human handlers.

*The remaining chapter considers domestication; the practices of modern breeding, husbandry, and economics that have led to cows producing ever more milk; the negative health effects for the cow, farmers, and the environment of these practices; alternative practices that honor the cow as a living being; and, finally, what this all means for responsible human action.*