Under Her Wing

I had been keeping chickens for a couple of years when the one named Buffy became broody. She clucked darkly when I reached under her to extract the eggs. In contrast to her usual soft, conversational-sounding bo-awk, which often ends with an upward inflection, Buffy's new cluck sounded threatening. She raised her hackles and even pecked at my hand as I lifted her off the nest and carried her outside.

"Buffy, there are no roosters here," I muttered irritably as I retrieved the eggs that she had laid and stolen from her flockmates. I felt sorry for her. Any woman who has struggled with infertility could feel with this baleful hen. A broody hen shuns normal activities, even eating, to incubate a clutch of eggs. She pulls feathers on her belly to make a brood patch, and carefully turns each egg several times a day to help the embryo develop normally.

The next day when I went to get the eggs she was back on the nest. She sat devotedly through the day as her flock mates ran after insects and grazed on summer grass. Something had altered Buffy's brain reward circuits so that she sat on the nest for days and then weeks.

Of this devotion Willam James, the founder of American psychology commented dryly, "To the broody hen the notion would probably seem monstrous that there should be a creature in the world to whom a nest full of eggs was not the utterly fascinating and precious and never-to-be-too-much-sat-upon object which it is to her." James was intrigued by animals' instinctive behavior, and he bucked a twentieth century trend by declaring that humans probably have even more instincts than other mammals.

I could feel Buffy getting lighter, and so I put a dish of food in front of her. She gave a few eager pecks and then lost interest. Many birds become anorexic in order to incubate eggs. In the film, *March of the Penguins* we learned that a breeding male emperor penguin does not eat for 4 months. The penguin genome carries instructions, triggered by some combination of environmental and internal cues, that lead adult penguins to stop feeding, leave the sea and waddle to the Antarctic interior, select a mate, brood an egg and raise the chick through the long winter. Developing anorexia is a crucial for breeding. Despite losing 40% of their body weight, emperor penguins must not eat their own or their neighbors' eggs or chicks.

About two weeks into Buffy's hopeless vigil I stopped to admire a carton of eggs at the Missoula Farmer's Market. When the egg vendor, Helen, learned I had some Buff Orpingtons, she asked if any had become broody. Apparently the breed is notorious for it. I told her about Buffy and my regret that she couldn't be a mother since she was so determined. Helen said, "You know, you can put fertile eggs under her and she will hatch them for you."

I'd been planning to get some baby chicks this summer but it's a lot of work keeping them safe and integrating them into the flock. Maybe Buffy could do it. As I was

wondering where I could find fertile eggs Helen added “You can even buy baby chicks and, if you put them under her at night and close up the nest box with cardboard and wait 15 hours, she will accept them as hers. But if you try to foster chicks on a broody hen in the daytime she will usually attack them. And you must wait until she has set for about 21days.”

It sounded like the instructions from a fairy tale but this folk advice comes from how genes behave. We are used to thinking of the genome as a blueprint guiding the development of an animal, but scientists are discovering that that genes turn themselves on and off throughout life in response to environmental or physical cues.

The information that her eggs have hatched leads to changes in patterns of brain gene expression that rewire a hen’s brain to mother, and that process takes about 15 hours. The brain’s response to signals that chicks have hatched is profound. Scientists found that oxytocin-secreting neurons increase in size and complexity and trigger hundreds of genes in many different brain regions at once. Increasing oxytocin receptor expression in the reward and reinforcement circuitry of the brain induces a state of focused devotion.

A broody hen that has set for 21 days is primed to hear the chicks’ peeps. Chicks begin calling while still in the egg, and this signal turns on a gene in a specific subregion of the auditory forebrain devoted to hearing. Within minutes a gene in the hypothalamus begins to produce oxytocin-releasing hormone. Oxytocin has been called the love hormone because it is responsible for the passionate attachment we feel after orgasm and when cradling our newborn. The same hormone that helps us fall in love with our babies helped Buffy bond with chicks purchased that morning from the local farm store.

Before gene sequencing no one knew that genes and the hormones they produce are highly conserved through species. But genomics researchers found that oxytocin-related compounds have played a key role in reproductive behaviors for 700 million years in worms, insects, fish, reptiles, mammal and birds.

That night, when Buffy was sleeping I put nine chicks in the nest, closed up the space and waited. In the morning when I removed the cardboard the chicks had disappeared. Buffy fluffed her feathers to twice her size and glared at me. When I picked her up chicks fell from her feathers. I moved her to a protected enclosure first and then got the chicks. As I released them, Buffy issued a stream of deep clucks; the babies rushed to her and dove under her body. Mom and chicks had fallen in love.

The first day she kept the chicks close and warm under her expanded body. When she moved she looked like a stately parade float, all fluffed up feathers, with tiny feet scrambling to stay under her. This must be the origin of the expression “to take someone under your wing.” People have kept hens for thousands of years and our language is rich with metaphors based on a chicken’s behaviors.

On the second day, I noticed that Buffy was dropping tiny food grains by the chicks’ beaks. A few days later she began scratching up bugs and worms, biting them into small

bits, and standing back while the chicks ate eagerly. I didn't see her eat anything herself. The chicks followed her movements like a swarm of bees; if one realized it was too far away, it ran to her in panic. When the other hens came near, Buffy pecked them. She attacked our cat so fiercely when he tried to stalk the baby chicks that he gave up that sport for good. Her behaviors were typical of mother chickens the world over.

The remarkable thing about all this skill and devotion was that Buffy was a farm store chick herself. She and her sisters grew up motherless. How did Buffy know how to be a good mother? Or for that matter, how do newly hatched chicks know how to peck at food and run to their mother from danger? How can nature endow mammals with such amazingly well adapted capabilities?

After a bout of activity Buffy and the chicks would suddenly retire to a corner to sleep. REM sleep, where most dreaming occurs, helps structure neural development in the fetal brain; in the last trimester before birth the brain is dreaming a majority of the time. It is during REM sleep that fetal chicks learn to run, peck and stay close to their mother. Dreaming continues to be important in learning, memory and problem solving all our lives. Dreaming is so useful that it evolved independently in birds and mammals.

Baby birds and mammals come into the world with specific skills, aptitudes and desires. The same genes get used over and over, but because they are switched on and off in different patterns, evolution has produced a wide range of body designs and behaviors.

Helen told me that she put some wild duck eggs under a broody hen. The ducklings hatched and everything seemed to be going well until they saw her pond. The ducklings ran to it, hopped in and began swimming--to the distress of their foster mother who frantically paced the shore clucking loudly.

How can the same genes and hormones produce attraction to ponds and ability to swim in baby ducks and aversion to swimming in chickens? Genomic researchers found that even small differences in the location of the brain cells that produce a particular receptor or an enzyme can result in the different behavioral responses. Variation in regulatory regions of genes determines how much of a particular protein is made, when it is expressed, and exactly where in the brain it is expressed.

For example, researchers studying the genetic roots of the different breeds of dogs discovered that a very few genes are responsible for the behavioral differences between retrievers, herders, pointers, and guard dogs. Wolves hunt by stalking, chasing, pouncing, grabbing, killing, dissecting, and carrying food back to the den. When people bred dogs for particular abilities they were inadvertently selecting single genetic changes that led to the breed's increasing desire to focus on one aspect of the wolf's instinctive behavior. A small change in one regulatory gene produces behavioral differences, so that herding dogs are fascinated with stalking, pit bulls have enthusiasm for biting, retrievers live to bring things back to you.

What about humans? Psychologists usually believe that we come into the world bereft of the animal instincts that helped our remote ancestors get along with others, hunt for food, find a mate, and care for their young. But it seems unlikely that evolution jettisoned the usefulness of genes, hormones and behaviors when we became *Homo sapiens*. In fact, modern evolutionists such as Steven Pinker, Sarah Hrdy, and Richard Wrangham argue that William James was right: evolution equipped us with sophisticated social skills to enable us to live together and rear our children through a protracted period of dependency.

Like hens, human mothers and fathers automatically do a number of things to help their baby, behaviors and attitudes that do not need to be taught. For example, new parents instinctively hold their baby at the distance her eyes can focus, they speak in the sing-song baby talk that is better for distinguishing sounds, they imitate their baby and follow her lead, exaggerating movements that help the infant learn what she is doing. Yet if you ask parents what they are doing and why they often can't tell you.

The dialog between genes and behavior goes both ways. Certain genes are turned on by the behavior of the animal itself. Researchers have found that when human fathers spend more time with their infants, oxytocin levels increase. Fathers' attentiveness leads to activation of genes that support his parenting behaviors.

What about Buffy? As the chicks grew Buffy began to eat more herself, but she continued to scratch up bugs for the chicks. When I threw cracked grain on the ground she would fend off the other hens while the chicks ate. I wondered when, if ever, all this selflessness would cease. Then one day I noticed that she was foraging side by side with her sister. When I threw out the scratch grain the adolescent chicks rushed in. This time Buffy pecked at them coldly. They retreated while the adult hens ate. Apparently the time for being a mother was past. The chicks were on their own.