Letter from the Desk of David Challinor
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"Look Ma, no hands!" is the exultant cry of the child who furiously peddles a bicycle with both arms hovering shakily above the handlebars. Most of us once experienced this overwhelming sense of triumph, this brief denial of the fact that the way to ride a bike is by steering it with your hands. We also tried bobbing for apples at birthday parties, and—although we snorted up plenty of water—few of us managed a single bite. Doing things "no hands" was an irresistible challenge, but it was just for fun. We never had to be told that hands are useful, convenient, and a crucial part of our bodies. Consider how handicapped are the mutilated, handless war victims of the Congo! This savagery—a legacy of earlier colonial punishment—renders its victims virtually helpless. Human beings are so hand-oriented that I can think of only a few sports or activities where hands are not really needed: soccer (except for the goalie), running races, and perhaps log-rolling and tap dancing. As highly evolved primates, we depend on our hands for carrying, writing, fighting, assembling all sorts of items, and a long list of other activities. One of the most important of these is conveying food to our mouths, and thinking about this prompted me to consider the ways in which animals with no hands survive. Fish and birds and snakes have no use for bicycles, but all living creatures must secure and ingest food.

Primates—many rodents, canids, felids and a host of other mammal tetrapods (vertebrates with two pairs of limbs)—manipulate food with their fore paws, much as we do. Pandas, with their unbending "thumb," are a good example.[1] Birds, however, lack forelegs (replaced by wings) and thus depend on their bills. Some birds such as hawks, owls and parrots, use both feet and bills to feed themselves, but most rely on bills alone. The Anhinga or snakebird, for example, has developed an extraordinary fishing technique. This cormorant-sized piscavore has a long, snake-like neck and an extended, sharply-pointed bill. As it cruises the shallow swamps of our southeastern states, it can slowly submerge so that only its head and neck are above the surface. When fishing, it submerges completely and, using its powerful webbed feet to propel itself, finds a suitably sized fish and, with the assistance of its flexible neck, harpoons it with its bill. After surfacing, it tosses the fish in the air, catches it in its open mouth, and swallows it whole.

Herons, on the other hand, generally catch a fish between their bills and then maneuver it by twisting their necks so that they can swallow it head first. Occasionally, the bird will determine that the fish or frog just caught is too large to be easily swallowed. The bird will then stab the prey on the ground or strike it against a rock to ease ingestion.

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[1] See Gould, Stephen, *The Panda's Thumb*, W.W. Norton & Co., Ltd., 1980.

Among waterfowl, the highly specialized bill of the Black Skimmer has no equal. This brightly-patterned, black-and-white bird is the size of a large pigeon, but much longer winged. The five-inch-long bill is bright red at the base and black at the ends, with the lower mandible about 20% longer than the upper. The upper is laterally compressed and fits neatly into the groove of the lower. This bird, which feeds mainly at night, needs flat water so it can fly over with its lower mandible below the surface and the upper one above it. When the lower contacts a fish, the bills snap shut, and the head flicks down with the bill pointing backwards along its breast. On the next wing beat, the bird raises enough for the head to straighten out, enabling the bird to swallow the fish in one gulp.

Skimmers seem to hunt by touch; they probably do not see their prey. Occasionally, they hit a submerged stick or even the bottom, and the head reflex is the same. To compensate for the stress of impact, the neck muscles are larger than normal, and the skull's attachments to the neck are particularly elaborate. One would think that this adaptation would not help the bird's efficiency at catching fish, but Skimmers are clearly successful fishers, and flocks of over a hundred are not uncommon.

The American and Black Oystercatchers also have a long, red, laterally flattened bill used to slip between the open shells of feeding oysters and other bivalves. Darting its bill rapidly between the bivalves' open shells, the bird deftly severs the oyster's adductor muscle, which opens and shuts the animals' shells. Quickly moving its head sideways, the Oystercatcher opens the oyster with its wedged bill and gulps the savory morsel.

A final unusual bill is that of the American Woodcock. This forest-dwelling, worm-eater probes the soft soil with its long (4"-5") bill. When the sensitive tip of its upper mandible contacts a worm, just the bill's tip curves up to grab the worm. Even after some research, it is still unclear how the exact mechanism works, but I can speculate that nerve fibers must run down to the bill's tip. I also cannot think of any other bird with a flexible beak. One more mystery for a budding naturalist to solve!

From handless birds with their efficient bills, let's move on to handless fish, which use suction to catch and swallow their prey. Fish, by rapidly opening their mouths, expand the oral cavity and force a current of water to enter, thereby carrying the food inside. With the next suck, the food is pushed back towards the throat where a set of specialized flat bones, called pharyngeal jaws, take over and force the food down the esophagus.

Although the sucking process is commonest among ray-finned fishes (salmon, tuna, carp, etc.), the Moray Eel has just been discovered to be a notable exception. This denizen of coral reefs has a large-toothed mouth, hides in crevices, and some of the 500 species grow as long as two or three meters. Most of us have probably only seen them in an aquarium. Unlike most other fish, this eel has no pectoral fins, and Dr. Rita Mehta of the University of California (Davis) believes that this anomaly has allowed the muscles that once may have controlled these fins to evolve instead to beef up the pharyngeal jaws.

In Moray Eels, this second set of jaws has wicked curved teeth; the entire assemblage fits deep in the back of its throat. When any swallowable fish passes its lair, the moray lunges out to grab it with its toothed front jaws. Instantaneously, powerful muscles propel the pharyngeal jaws from its throat to grasp the prey again. This action allows the eel to disengage its front jaws, while its second set retracts back into the throat, pulling the prey into the esophagus. No other animal has yet been found that feeds this way.

As a footnote to the sucking technique employed by most fish, one large mammal, the Sloth Bear, has evolved to suck termites, a favored food, from their nests. Alone among ursids (bears), the Sloth Bear has evolved to have no front teeth. This allows its large tongue to curl cylindrically through the gap to suck up its prey. All the other mammalian termite eaters use sticky tongues to move termites to their throats.

The last group of eaters to consider is made up of those that scavenge carcasses or attack prey much larger than they can swallow whole. Sharks, for example, when consuming a dead floating whale, bite a jawful and then roll their bodies over to sever the meat from the carcass. Their three rows of backward facing teeth help move their mouthful to their esophagus. Crocodiles and their kin also have to rotate their entire bodies to sever the meat they have clamped on to, because their necks are rigid.

Snakes are the terrestrial equivalents of eels, and they have evolved an extraordinarily efficient way to down their meals, including morsels larger than their gape. Being limbless, like fish, they use only their mouths, unhinging their jaws and then alternately moving the left and right sides of their upper jaw until they have "walked" the rat, the egg, or whatever they are eating, down their throats.

All the strange feeding mechanisms I have described should make us even more aware of how blessed we are to have hands—and such efficient ones at that! We are the only primates equipped with an opposable thumb. That is, we can touch the end of each finger with our thumb. Even the dexterous chimpanzee cannot do this. It is this unique anatomical feature that allows our species alone to micromanipulate objects. We can repair watches, do intricate needlework, tie sutures with one hand, play a multitude of musical instruments with both. I believe our wondrously agile hands have contributed almost as much as our disproportionately large brains to our current evolutionary status at the top of the heap. I hope you noticed that I used the word "current." Let's hope we can stay there. The entire top-heavy heap could collapse if we fail to curb our seemingly insatiable demands on the resources of our fragile planet.

David Challinor
Phone: 202-633-4187
Fax: 202-673-4686
E-mail: ChallinorD@aol.com