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Extravagant Results of Nature's Arms Race

By [NICHOLAS WADE](#)

Nature is reputed to be red in tooth and claw, but many arms races across the animal kingdom are characterized by restraint rather than carnage.

Competition among males is often expressed in the form of elaborate weapons made of bone, horn or chitin. The weapons often start off small and then, under the pressure of competition, may evolve to attain gigantic proportions. The Irish elk, now extinct, had antlers with a span of 12 feet. The drawback of this magnificent adornment, though, was that the poor beast had to carry more than 80 pounds of bone on its head.

[In a new review of sexual selection](#), a special form of natural selection that leads to outlandish armament and decoration, Douglas J. Emlen, a biologist at the University of Montana, has assembled ideas on the evolutionary forces that have made animal weapons so diverse.

Sexual selection was Darwin's solution to a problem posed by the cumbersome weapons sported by many species, and the baroque ornaments developed by others. They seemed positive handicaps in the struggle for survival, and therefore contrary to his theory of natural selection. To account for these extravagances, Darwin proposed that both armaments and ornaments must have been shaped by competition for mates.

In his view, the evolution of the armaments was driven by the struggle between males for females, whereas the ornaments arose from the choice, largely by females, of characteristics they prized in males. Modern biologists have devoted considerable attention to female choice and how it has led to such a riotous profusion of animal high fashion, from the plumage of birds to the colors of butterflies. Less attention has been paid to the equally rich diversity of animal weaponry.

Dr. Emlen said he became interested in animal armament after studying a species of dung beetle in Panama that specialized in monkey scat. He broadened his studies to dung beetles worldwide and noticed a pattern in their weaponry. Dung beetles may have started their highly successful career feeding on dinosaur ordure, and seem then to have diversified to that of mammals. They have two principal strategies. Some, like the scarabs, cut out pieces of dung and roll it away for private consumption. Other species dig under a deposit and draw it into their tunnels.

Dr. Emlen noticed that only the tunneling species of dung beetles had evolved horns, which the males use to protect their tunnels from other males. The beetles that push balls of dung away also fight all the time with other males, but are hornless.

“I became fascinated by animals with strange morphologies that make you wonder how in the world they could possibly have mated,” Dr. Emlen said. After collecting papers on “anything that had funky structures,” he began to see a pattern in who developed weapons and who did not. Whenever there was some resource that could be monopolized and used for reproductive advantage, males would develop weapons to fight off other males.

The cost of developing and carrying the weapon, Dr. Emlen inferred, was outweighed by the greater access to females gained by owning some prized possession like a food source or tunnel where females could lay eggs.

Dr. Emlen noticed a tendency for weapons to start out small, like mere bumps of bone, and then to evolve to more ornate form. The small weapons are actually quite destructive since their only role is to attack other males. But the more baroque weapons, even though they look more fearsome, seem to cause lesser loss of life.

The reason is that the more menacing weapons have often acquired a signaling role. Instead of risking their lives in mortal combat, males can assess each other's strengths by sizing up a rival's weapons, and decline combat if they seem outclassed. The ornate weapons also lend themselves to ritualized combat in which males may lock horns and assess each other's strength without wounding each other.

“The most elaborate weapons rarely inflict real damage to opponents, but these structures are very effective at revealing even subtle differences among males in their size, status or physical condition,” Dr. Emlen writes in the current *Annual Review of Ecology, Evolution and Systematics*.

Since the weapons still have to be used from time to time, they are realistic signals of a male's fitness. This information is of greatest interest to females, which are always looking for true, unfakeable signals of a male's quality. Geerat Vermeij, an evolutionary biologist at the University of California, Davis, and an expert on the arms race between mollusks and their predators, said he agreed with Dr. Emlen that weapons began as soon as there was something to be defended. But Dr. Vermeij said he was “skeptical of the conclusion that initially harmful weapons turn into display weapons.” Crabs, for instance, lose claws a quarter of the time in combat, he said.

Scott Sampson, a dinosaur expert at the Utah Museum of Natural History, said that among hoofed animals, weapons often became less dangerous when the animals started to live in larger herds and males would cooperate in defending females against predators.

How much of this theory of male weaponry applies to a group not included in Dr. Emlen's survey, that of primates, in particular humans?

People have pathetically puny teeth and claws compared with the armaments of other dominant species. This is a sign not of pacific intent but of the fact that they manufacture their weapons. The manufactured weapons, just like biological ones, have assumed a display function — think of the fearsome appearance of samurai helmets or armored knights, or the menacing tanks and rockets that paraded through Red Square in Moscow in the days of the Soviet Union.

Male primates of other species often use displays in competing with one another, and the displays “do seem to resolve disputes without actual physical violence,” said Robert Seyfarth, an expert on primate behavior at the [University of Pennsylvania](#). Especially among baboons, the displays often take the form of yawns, which provide males the opportunity to exhibit their impressive canine teeth.

Another display used by baboons to intimidate rivals is their “wahoo” call, which can be heard over several kilometers and is one of the loudest given by any terrestrial mammal.

Among people, speech and other behaviors may have played roles along with weaponry in impressing other males and enchanting females. It is “very reasonable to assume that, as humans evolved and our culture became more complex, skills in tool making or other cultural behaviors took over from anatomical traits as ‘markers’ of a male’s competitive skill,” Dr. Seyfarth said.

But there is less reason to think that human weapons became less destructive as they grew more elaborate, as Dr. Emlen argues is the case with animal weaponry. Occasionally a new weapon has seemed too terrible for general use, like the crossbow, which the church ruled could be deployed only against Saracens and not against fellow Christians. But the restraints would soon disappear as the weapon grew familiar, and only in the modern age, with the advent of chemical, biological and nuclear arsenals, have people produced weapons they seriously hesitate to use.

“We have not reduced the lethality of our weapons, even though we do in fact bluster and use them for display as other animals do,” Dr. Vermeij said.

Dr. Emlen’s interest is not in how his evolutionary rules of weaponry might apply to people, but in why weaponry among animals is so diverse, from the gigantic horns of the rhinoceros beetle to the macelike tail of the ankylosaur and the saws on sawfish. His answer is that a variety of evolutionary processes drive the evolution of weapons, from competition between males to display functions and the general rapidity of sexual selection. The moral of the tale, at least for animals, is that a weevil that starts an arms race may end up with descendants armed like a rhinoceros beetle.

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