Most X-ray pulsars are neutron stars accreting matter at still higher rates (around 10^{18} g s^{-1}) from more massive binary companions; the high accretion rates combined with strong surface magnetic fields inhibit thermonuclear flashes and prevent the emission of X-ray bursts, while the fields funnel the accretion flow onto magnetic polar regions, giving rise to pulsations as the star rotates. Finally, any of these neutron stars could instead be a radio pulsar if the surface magnetic fields were sufficiently strong (and misaligned with the rotation axis) and/or the stellar rotation period were sufficiently short to turn on the pulsar emission mechanism; the radiation and particulate wind generated by the radio pulsar would then quench any accretion and would thereby prevent the star from exhibiting other γ-ray or X-ray phenomena. □

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EVOLUTIONARY BIOLOGY

Borrowed sexual ornaments

Jared M. Diamond

SECONDARY sexual structures may serve not only as signals to attract mates and dominate rivals, but also as a way of reproductively isolating one species from another. So we hardly expect one species to borrow another's ornaments. Such a discovery by Frith and Frith[1], reported in *Emu*, is all the more remarkable because the particular ornament borrowed is one of the most bizarre in the animal kingdom. The observation illuminates the much debated question of whether sexual ornaments are mere arbitrary neutral characters or are valid indicators of a suitor's quality.

The structures in question are the occipital plumes of the adult male King of Saxony bird of paradise (*Pteridophora alberti*), a thrush-sized bird found only in New Guinea cloud forest. From above each eye springs a highly modified feather several times the bird's length, resembling a fine wire bearing dozens of squares of blue plastic (see figure). When the first stuffed *Pteridophora* skin reached Europe in 1894, the then-curator of birds at the British Museum (Natural History) bristled with indignation — in his view even a fool could recognize the supposed bird as a pasted-together, man-made artefact.

The borrower is Archbold's bowerbird (*Archboldia papuensis*), a little-known species occupying the same habitat as *Pteridophora*. Like other bowerbirds, male *Archboldia* construct and decorate a bower by which females select a mate. Frith and Frith found that the central mats of six out of twenty *Archboldia* bowers examined were decorated with an average of three and a maximum of six *Pteridophora* plumes. The plumes and their position were evidently highly important, because the bower-owning *Archboldia* male moved the plumes back to the centre of the mat when Frith and Frith shifted them to the edge.

For years there has been vigorous argument over whether sexual ornaments are arbitrary signals of no intrinsic value (Fisher's runaway model[2]), 'good' traits serving as direct indicators of owner quality (truth-in-advertising[3]), or burdensome traits demonstrating the owner's ability to survive despite such an impediment (Zahavi's handicap principle[4]). These hypotheses are normally applied to ornaments that are part of an animal's body, but they can also be applied to the ornaments with which a male bowerbird decorates his bower. What message is conveyed to *Archboldia* females by the presence of *Pteridophora* plumes in an *Archboldia* bower?

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

Plumes for the pinching, here on their rightful owner the male King of Saxony bird of paradise. (Painting by William T. Cooper, reproduced with kind permission.)

The plumes must be difficult to come by, because male birds of paradise acquire them only at an age of four to seven years and moult only once a year, and because *Pteridophora* is an uncommon species of a notoriously impenetrable habitat where moulted feathers are hard to find. Males of other bowerbird species are known to steal prized ornaments from each other's bowers. So a female *Archboldia* finding a bower with several *Pteridophora* plumes knows at once that she has located a dominant male who is terrific at finding or stealing rare objects and at defeating would-be thieves.

Australia's satin bowerbird similarly decorates its bowers with uncommon, often stolen, blue parrot feathers, though these are not nearly so rare as *Pteridophora* plumes[5]. But acquisition and retention of rare objects are not the sole truthful signals by which a male bowerbird can advertise his superiority. Frith and Frith note that another species, the tooth-billed bowerbird, decorates its bowers just with leaves that are not at all rare. Among Vogelkop gardener bowerbirds, whereas one population prefers blue objects as does the satin bowerbird, another uses acorns and snail shells which are abundant. But bowers of both populations are still massive, intricately woven edifices, decorated according to a complex design with hundreds of objects, including leaves two metres long and weighing half the weight of the male himself[6]. It is as if a woman were to put her suitors through a sewing contest, chess tournament, boxing match and weight-lifting contest before going to bed with the winner.

The discovery by Frith and Frith therefore adds to the evidence that male bowerbirds' ornaments signal their owner's superiority through the truth-in-advertising principle. For the same reasons implicit in *Archboldia*'s choice, *Pteridophora* plumes are also prized by males of yet another New Guinea montane species: highland men, who use the plumes to decorate their headdresses. Ironically, however, the message to a female *Pteridophora* herself is probably a different one. *Pteridophora* plumes mounted on their rightful owner surely signal male quality by Zahavi's handicap principle, because only the most superior bird could navigate his way through New Guinea's cloud forest while sporting plumes several times his own length. □

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