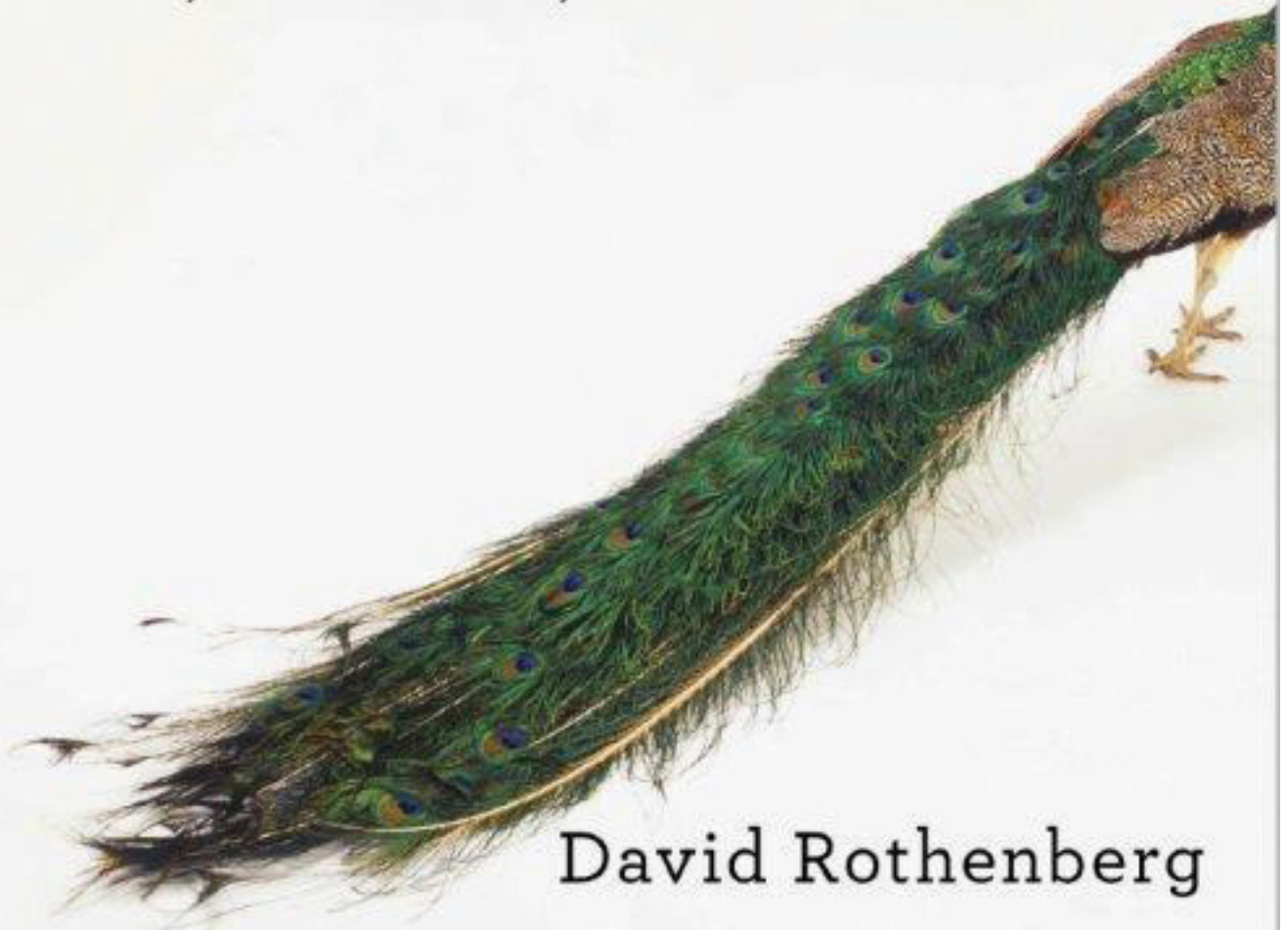


SURVIVAL *of the*
BEAUTIFUL
ART, SCIENCE, AND EVOLUTION



David Rothenberg

Survival of the Beautiful

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BY THE SAME AUTHOR

Is It Painful to Think?

Hand's End

Sudden Music

Blue Cliff Record

Always the Mountains

Why Birds Sing

Thousand Mile Song

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SURVIVAL OF THE BEAUTIFUL

ART, SCIENCE, AND EVOLUTION

David Rothenberg



BLOOMSBURY PRESS
New York Berlin London Sydney

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*For my mother,
a great artist and teacher*

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Contents

CHAPTER 1

Come Up and See My Bower 1

CHAPTER 2

Only the Most Fascinating Survive 27

CHAPTER 3

It Could Be Anything:
Male and Female Animals in Their Art Worlds 61

CHAPTER 4

Pollock in the Forest:
Abstraction as Measure of the Real 102

CHAPTER 5

Hiding Ingenuity, or Think Like a Squid:
Camouflage Between Art and Nature 132

CHAPTER 6

Creative Experiments:
When Science Learns from Art 168

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—+1

CHAPTER 7

The Human, the Elephant, and Art Out of Relationship 202

CHAPTER 8

The Brain in the Cave:
Art at the Edge of Human Certainty 232

CHAPTER 9

One Culture of Beauty, Between Art and Science 254

Acknowledgments 283
For Further Reading 285
Notes 291
Illustration Credits 301
Index 303

It Could Be Anything

Male and Female Animals in Their Art Worlds

RICHARD Prum remembers the first time he saw a bowerbird. “The first time I saw a golden was in Queensland, up near Cairns. Mostly brown with bright yellow in the back of the head; they make a double maypole. I kept my eye out for the bower. I had previously seen satin bowerbird avenues, and they are a foot or so tall, so I was walking carefully, making sure I wouldn’t step on it. Then I rounded a bend and came across one and it was like three and a half feet high and four and a half feet wide! You’re not gonna step on this thing! What was amazing about it was that one side was ornamented with these beautiful forsythia-colored flowers, just this pure banana-ish orange-yellow. Like its own head. The other side was threads of this electric-green lichen. There was not a single piece that was out of place. One half exactly symmetrical to the other, yellow versus lime green.”

His mood is one of pure aesthetic amazement, just what the female bowerbird is meant to feel. Pure delight. An artwork made exactly for her, just the way she has evolved to like it. The sense of taste is absolutely there. Arbitrary? Not for the female bowerbird. Essential, necessary, certain in a way human art worlds can never be.

Prum is professor of ecology at Yale University and curator of birds at the Peabody Museum. He is one of a few top-level scientists who believe that beauty has gotten short shrift in our study of evolution. (I hope that after you finish reading this book, there will be a few more.) He stresses that the artworks of male bowerbirds must first and

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foremost be beautiful for female bowerbirds. “We humans might not always like what we see. The work of some bowerbirds is more outlandish than beautiful to us. Archibald’s bowerbird in New Guinea builds his bower on top of sharp ridges. The whole thing drops off steeply on two sides. They get all these little red and blue fruits, and in this case it is a maypole bower, with a sapling and then all these other horizontal twigs stuck in. Looks like a Christmas tree with some way crazy ornaments. Hanging on all these horizontal twigs are little pieces of brown caterpillar shit! What’s so beautiful about caterpillar shit? He likes it because he knows she will.”

What have other scientists said about these birds’ wonderful creations? Gerald Borgia writes that the collection of seashells and berries suggests a bountiful cornucopia, a wide-ranging healthy diet. Others suggest they are all anti-rape structures, allowing the females to give adequate consent before mating is going to happen. Prum is not at all convinced. He believes the vast diversity of life is there simply because it was possible to evolve. Evolution has tried out the most interesting possibilities and look what it has come up with! We shouldn’t be afraid if nobody can explain it.

Richard Prum once had some of the finest ears in ornithology. He traveled the world cataloging birds solely by their sound. “I used to be able to go to South America, listen my way through an avifauna of three hundred species, find the bird I’m looking for, and describe its behavior. I was an expert in listening.”

Then in Senegal he picked up an unnamed tropical virus. Hearing in his right ear started to go. “My hearing became monaural. The challenge at first was that I could hear all the birds that everybody else could hear; I just couldn’t *find* them. It was like living in a flat world. I could still hear—oh, that is a warbler—but where the hell is it? In the early to mid-nineties I started having problems in the opposite ear. I had no idea that my right ear was going to be the *good* one.

“Nineteen ninety-eight was the last time I went to Madagascar to study the velvet asity. By the time I got there, I had three or four field assistants, we were on the trail in Madagascar and we got up to the site and our bird was still hanging out in the same territory. A little bigger

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than a warbler, smaller than a thrush, iridescent black, short tail, and he kicks backs his head, opens his mouth, and I couldn't hear a damn thing. That was totally painful. Here was this high, squeaky song that I was the first to describe. We published a sonogram, we recorded it—now I couldn't even hear it. Terrible, devastating. This, I thought, was the end of my career.”

Modern hearing aid technology has restored Prum's hearing in one ear to the extent that he can speak and carry on a damn good conversation even in fairly noisy circumstances, but he still can't get those high, crisp bird notes essential for bird song work. “I'm glad I can still hear functionally, but the effect on my work was catastrophic. I felt like shit. Here I was in midcareer, having to totally switch gears. That's how I got interested in the color of birds and how feathers really work. There have been people who said, ‘Oh, it is so fortunate for you—if this hadn't happened you wouldn't have gotten into feathers and that is what brought you to Yale.’ That is totally bogus. It sucks.”

Through advances in genetics Prum has been able to make amazing strides in understanding how the DNA in a single bird cell contains all the information necessary for feathers to properly grow and to present the creatures' distinct colors, appearance, and layout with astonishing detail. The technique is so good that recently Prum and his team became the first to accurately discover what color a dinosaur really was, bringing him newfound fame on the stage of truly amazing scientific advances. For his work on understanding the genetics and systematics behind how feathers form, Prum was awarded a MacArthur Fellowship in 2009.

“An award like this is either a blessing or a curse, because it recognizes quirkiness, not usually mainstream acceptance,” Prum notes. He does see himself as a maverick, a scientist out on a limb in his field, not because of his genetic discoveries but because he takes seriously something most evolutionary biologists do not: beauty.

AFTER Charles Darwin wrote *On the Origin of Species*, explaining how evolution marches on by making possible species that are uniquely

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adapted to their environments, he realized there was a real hole in his argument. He still couldn't explain the peacock's tail. How could such a flamboyant display of feathers of such great complexity be a trait that has evolved as an adaptation to any challenge of environment or fitness?

In his next major book, *The Descent of Man*, Darwin emphasizes the idea of sexual selection, whereby females of the species evolve a sense of taste and discrimination that favors certain beautiful features in the males. These features are selected for generation after generation simply because the females like them, because their aesthetic evolves over the millennia to define the salient qualities of the species. For Darwin it is important that those features chosen to be beautiful may in fact be *arbitrary*—that is, they have no distinct function apart from the fact that females have evolved to like them. Once they have been selected for over time, the fact of the peacock's magnificent tail is no longer arbitrary in defining the species. It has come to be that bird's defining characteristic, but only because females have evolved to appreciate it.

Sexual selection, says Prum, is really a matter of the evolution of aesthetics in nature. The evolution of all these beautiful bird songs, these ostentatious patterns of bird feathers, and the fabulous performances in bird displays are all for the delight of the female. In sexual selection according to Darwin, aesthetics is central. Today biologists tend to understand sexual selection as an indicator of "general male quality," an even more nebulous idea whereby anything beautiful—a tail, a song—is supposed to show that a male is stronger, more fit, and better at things such as mating, parenting (if that's part of the species requirement), and genetic viability.

To Prum, this misses the point. We are trying to explain away aesthetics by refusing to consider aesthetics, instead jumping immediately to what it is supposed to indicate. By sticking more closely to Darwin's original views, Prum is encouraging scientists to admit that particular aesthetic traits are arbitrary—as the selection process began millennia ago, it could have been anything! The species gets defined by the increasing preference for the trait over many generations, and then you

have the coevolution of the art of the male animal and the aesthetic appreciation of the female. The work evolves together with its public, and Prum finds he can learn more from the art world theory of philosopher and art critic Arthur Danto than he can from biologists who try to deny that sexual selection is actually separate from natural selection. “They’re stuck with Darwin book one, denying the importance of Darwin book two. I want to recognize the importance of both books, and celebrate the delight and taste found in nature as depicted in the second.” So the key to understanding sexual selection is not to subsume it into natural selection but to keep it separate, recognizing that it is a key understanding that nature is actually beautiful, because the traits we find there have evolved together with something much harder to see but just as real, a sense of aesthetic appreciation.

“When Darwin came up with sexual selection, he came up with two modes, male/male and male/female, and what happened immediately was that the armaments that evolved by male/male competition immediately became accepted, the idea that big macho males could compete with each other for sexual success. People loved this, since it fit right into cultural Darwinism with a sexual twist, what could be better than that?” But the idea that females select males on the basis of traits that they arbitrarily consider to be beautiful was taken much less seriously for more than a century. It seemed frivolous, inappropriate for a domain as serious and carefully evolved as nature and the whole realm of life. Male/female sexual selection went into popular culture, into the writings of Wilhelm Bölsche and his ilk. We had to wait nearly a hundred years before new developments in science brought it back to biology, in ways that Prum considers to be totally misguided.

“What happened was there were several pieces of theory that suddenly made female preference relevant. My perspective is that the vast majority of the literature since 1983 has made a horrible turn in the wrong direction,” comments Prum. Amotz Zahavi, the Israeli biologist, put forth a theory that tries to turn sexual selection into natural selection, by suggesting that ornaments previously considered to be outlandish are coded indicators of general male quality and viability. Says Prum, “Zahavi claimed in a backwards sort of way that there really

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must be a *reason* for the peacock's tail. Ornamentation evolves as a consequence of natural selection on female preference to prefer those variations in trait that actually give her either direct benefits, such as I'm going to be a good dad and feed the young, or indirect ones: I've got good genes. But the genetics are tricky, they only work if the cost of the tail is greater than the benefits."

So Zahavi is imagining that the peacock's tail tacitly says, *Look how strong and solid I am. I can carry around this huge useless tail and still get around okay and avoid being snapped up by predators. I'm the guy for you.* Darwin did not see it this way. He said that ornamental traits *delight the mind* of the female. As Prum puts it, "It's about charm; it's about beauty." By contrast, Zahavi uses Darwin's first major work to argue against his second: *Origin of Species* trumps *Descent of Man*. He makes Darwin's mechanism even more Darwinian by putting sexual selection *under* natural selection. Female choice is now seen as being part of an adaptive strategy, suggesting that there should be a real difference in quality between the males that the females choose.

Zahavi's view has convinced most biologists today, and this is what they probably taught you in your college biology class. "They prefer to obfuscate the whole thing by arguing that females are constrained by a *need* to select for fitness, instead of according to the whims of fashion," remarks Prum. "In a cultural sense, this is very creepy. Darwin said that when females are in charge, beauty evolves." The Victorian era was threatened by this, and biology may still be threatened by the idea that the cumulative effect of female choice might guide the development of beautiful, fanciful traits in nature for no rhyme or reason whatsoever.

Prum is worried that in trying to go back to the original sense of what Darwin meant by sexual selection, he stands alone among biologists. "What happens when female preferences are *not* under natural selection? What if all males are basically equivalent? All the birds I work on are lek species, which means that the males do displays on an open ground where the females are supposed to assess their ornaments and their performances. To explain those ornaments, ornithologists have to say one male is *actually* better than the other. I just don't buy

it.” In a few cases biologists can find examples where a male with one particular trait turns out to be more genetically viable. But not in most cases. What do scientists do? They ignore all the many cases that don’t fit their theory, and focus only on the few that do.

“People are so convinced by this adaptationist view that they comb through nature and find just *one* species that fits their model, and ignore all the others. It’s the worst kind of science,” Prum says. They ignore what is actually created by the male birds: the actual bower, the actual song, with their interesting, largely unstudied, and, according to Prum, arbitrary qualities that could be anything as long as generations of females have evolved to prefer it. Since the questions of form and beauty seem far from useful things such as questions of sperm quality, these biologists fail to even ask the most interesting questions anymore, such as why birds sing the songs they sing, or why bowerbirds have evolved to make artworks that seem so far from the practical and the useful. Says Prum, “In order to avoid an actual description of the mysterious arbitrariness of nature, we have to ignore almost everything interesting.”

This is something I had long noticed in bird song science, but I had never met a scientist who would agree with me as simply and plainly as Prum. For example, in England, it has been noted that in the case of the sedge warbler, a male who sings a longer and more complex song has greater mating success than all the other males. Does this prove the song indicates greater male quality? Not necessarily, but it does show that the females do like length and complexity in their music. That’s their preferred aesthetic. But consider a closely related bird, the European marsh warbler. This one sings the most complex of all European bird songs, an amalgamation of all kinds of fragments of African bird songs that it learns during its winter migration. No other bird we know of does anything like this. But in this species, there is no clear correlation between singing ability and anything else. So no students have been encouraged to study it, because it doesn’t fit the simplistic model. In *Why Birds Sing* I presented a somewhat romantic idea that science will never be able to explain such wonders. Prum is trying to convince me instead that science might well be able to elucidate

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them someday, but it must ask better questions. Perhaps, more beautiful questions.

Biologists are afraid of sexual selection because it always claims a certain amount of arbitrariness. If we demonstrate that it does work, what are we able to prove or predict about nature? Only that nature works in mysterious and beautiful ways. The world is less machine and more art. Prum is not afraid of this, and he believes that evolved traits are arbitrary until proven adaptive. This is where we should start, instead of the other way round.

He wants to bring back to the fore the work of R. A. Fisher, who proposed very briefly in the 1920s how sexual selection might practically work. He was the originator of the “runaway model” of sexual selection, where evolved traits could get totally out of hand through generations of one-sided sexual selection. “In order to tell the story better, you have to get into some genetics, get under the hood, and see how it works,” continues Prum. “Fisher’s two-page verbal model was turned into useful math by Lande and Kirkpatrick in the early 1980s. That provides the bones for all of Zahavi’s models.” The runaway is one extreme consequence, but the original model is far deeper.

“Let’s imagine that we just start with genetic variation for trait and preference. Every individual has genes for both, but they only express whichever one is associated with their sex. Any individual could be plotted based on what would be the product of its preference or trait genes. Let’s start out with a null distribution, a blob in the center.

“What’s going to happen as a consequence of mating? Females who like long tails will mate with males who have long tails. Females that like short tails will mate with these here. But there will be very few matings where preference and trait do not match. You end up with a genetic correlation between trait and preference. What that means is certain types of evolution come easily. At the heart of the Fisher runaway process is the correlation between genes for preference and genes for traits.

“Now let’s look at population space, with average preference and average trait. It was recognized by Fisher, and later by Lande, that the trait to have is what most females prefer. Males should match the pref-

erence of the population. The best way to be sexually successful is to be popular, to be what females want. Done! Nothing complicated here. The more complicated question is Freud's: 'What do females want?' The conundrum is, it's easy to observe the traits, but it's impossible to know what's going on inside the minds of tropical bird females. How female preferences evolve is what is most opaque.

"What's cool about the Fisher hypothesis is that it says any trait can evolve. What males end up evolving is totally arbitrary; it can take *any* form. What's amazing is that they take a form that is determined by female preference—the function of that plumage or display in the mind of a history of females who have observed it." The feathers and the song function not in the external world but in the mind of an appreciating individual female. They possess meaning only in an aesthetic world.

But the vast majority of biologists say that female preference is *under* natural selection. Take a male bird who is bright red—say, a house finch. The red pigment in the house finch is assumed to come from carotenoids in what the bird eats. Carotenoid-containing foods are rare in the finch diet, so a bird that has a lot of it is supposed to have succeeded where most others have failed. By putting the red in his plumage, he is supposedly telling females how great his diet is and how fit he would be as a potential mate. But the house finch mainly eats seeds, the part of plants with the *least* amount of carotenoids, so although he is most definitely red, it is not because of what he eats. "The fact is that most evolutionary biologists have a very narrow comfort zone. They think that their job is to explain the world by natural selection. But it doesn't explain everything," says Prum.

What is Prum's alternative? He says to start by considering the specific nature of sexually selected traits to be arbitrary. "In this case 'arbitrary' is defined as a feature that provides no additional information about the male, it merely corresponds to female preference." It indicates nothing more than what females have evolved to prefer. Instead of ending with Fisher, we start with Fisher. Fisher's runaway model is the null hypothesis, the place where our understanding should begin.

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Prum mentions the courtship displays of a family of manakin species in South America. In most of these species the male flies down on a log, jumps up, turns around in midair, and lands with his head down and tail up. But one species lands in a totally opposite way, with head up and tail down. “Most of my colleagues would say there must be some kind of reason for this. I would argue that it must be totally arbitrary. They tell me you can’t say it’s arbitrary until you’ve tested every other adaptive hypothesis. What else other than natural selection can shape preference? Is the ability for preference to evolve structured by the nature of the brain? I would answer hell yes! In birdsong we can identify many relationships that are present in human music; those convergent intelligences have structured the same preferences.” In bird display there are elements parallel in human dance, and in bowerbird sculpture one finds certain principles that artists know quite well.

Why do the females prefer one trait and not something else? I ask Prum if science might be able to answer questions of aesthetics like this one. He is optimistic: “There is a science that will. We just aren’t asking the right questions yet. If you go to books on sexual selection, you will find there is not a single example of a completely arbitrary trait that the literature will accept! They only publish on the things that support their adaptive paradigm! How are you going to get a job unless you are firmly connected to the prevailing view? The rebels to the norm have not yet arisen.”

I ask if there are other biologists who agree with him. “I’m almost totally alone on this,” he laughs. “They all drank the Zahavi Kool-Aid.”

Many biologists think of sexual selection as the explanation of last resort. I remember when I was speaking with Martin Nweeia about his research into the tusk of the narwhal, the longest tooth in the animal world. Long considered a purely sexual ornament because only the males have it, Nweeia concluded that it is actually a sophisticated sense organ that can give the whales precise information on the temperature and salinity of the water they navigate through. “People choose sexual selection as the explanation when they have no idea what an animal’s feature is for,” he told me. That’s the other view on the story, that sexual selection is sort of a cop-out, an avoidance of serious attention to

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natural mystery. But how much do we need to find a reason for beauty? No adaptive explanation, no matter how ingenious, can erase the sheer magnificence of what nature has managed to evolve. The progress of science must find a way to acknowledge such an insight.

“To me, the expansively arbitrary diversity predicted by the null [Fisher hypothesis] looks a lot like the overwhelming, multidimensional diversity of secondary sexual display traits in nature. Is this account anywhere near accurate? Currently, intersexual selection research is structured to prevent us from being able to find out. Adopting the [Fisher process] as the null model in intersexual selection will permit us to do so for the first time,” writes Prum in his first essay on the topic, proclaiming the Fisher process the null model in sexual selection, which basically means that most of the time, what females prefer is totally arbitrary, and we must delve deeply into this arbitrariness. Let’s assume Fisher is right, and consider adaptive explanations in sexual selection only when we have real evidence of them. Don’t let a prejudice against random beauty get in the way of our experience of it! This incessant quest for function is missing the point.

Then how can we better understand natural beauty? Prum says we should consider the whole thing as a form of art. This is an area where we have thousands of years of appreciation of the presence of beauty and the ability to articulate that, revealing how human perceptions of it have changed and culturally evolved.

RICHARD Prum may be the only biologist to have been seriously influenced by the aesthetic views of philosopher Arthur Danto. Danto, professor of philosophy and longtime art critic for the *Nation* magazine, has become unusually influential for a theorist among artists and art lovers today, because he is one of few writers to celebrate the fact that *anything* can be considered art today, no matter how mundane, spectacular, beautiful, ugly, or downright repellant. It need not matter what the object is; what’s important is just the fact that the work is put forth for our aesthetic contemplation. If something is in front of us in a gallery, museum, or sculpture park, it is offered up as art. If it is

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performed in a concert hall or theater, it is performed as art. If it is published in a certain way on the page, it is poetry, not prose. If it is on display, in one of the contexts for aesthetic imbibing, it is and can be and must be accepted as art, even if we might not see the skill involved, the technique, the expertise, or any claims to mirror or reflect reality in the thing itself.

In 1917 Marcel Duchamp tipped a urinal on its side, signed and dated the pisspot “R. Mutt, 1917,” named the work “Fountain,” and submitted it to the New York Armory Show, which stated that all work would be accepted. It was never actually displayed during the exhibit, and at the time no one knew the noted Duchamp was behind this stunt. Shortly afterward the original was lost. Some artists even today consider this to be the most significant artwork of the twentieth century, presumably because of its incredibly liberating suggestion: that anything can be art if we say it is.

I always thought that the main thing here is that Duchamp tipped the urinal *down* to make its lovely form more easy to see, offering us something rather modern, clean, pure, and beautiful to contemplate, smile at, and laugh at—a full-blown aesthetic experience, as satisfying as a long piss, full of all kinds of references and layers. But at the same time I wouldn’t want to dwell on it or defend it too readily. As in the case of John Cage and his famous musical piece of pure silence, this is an artist who made many other more interesting works. The extremes of these guys and this period make for good propaganda, but dwelling on them is more useful for denouncing art than defending it.

Arthur Danto and his many followers think otherwise. They consider Duchamp’s “Fountain” to be one of the greatest works of the twentieth century because it paves the way for the work of art to matter less than the act of setting up a situation where meaning can be discussed. The conversations that follow from the aesthetic experience will now matter more than the experience itself. Art, at last, will have become philosophy. This harks back to the ancient thinkers who wanted almost every practical problem turned into philosophy. Whatever leads to greater careful thinking and reflection is of the greatest value.

So what is good art? That question doesn’t matter. How to respond

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and care about art? This is what matters to Danto. He first articulated this view in an essay called “The Artworld,” which appeared in 1964, when a lot of people seemed very perplexed by the work of a young upstart artist, Andy Warhol. How dare he paint replicas of Brillo soap-pad boxes out of wood and stack them in a gallery for our contemplation and our purchase?

And why need Warhol *make* these things anyway? Why not just scrawl his signature across one? . . . Is this man a kind of Midas, turning whatever he touches into the gold of pure art? And the whole world consisting of latent artworks waiting, like the bread and wine of reality, to be transfigured, through some dark mystery, into the indiscernible flesh and blood of the sacrament? Never mind that the Brillo box may not be good, much less great art. The impressive thing is that it is art at all.

For Danto, though, it’s only art if you know enough about how art got to this point:

In order to see it as part of the Artworld, one must have mastered a good deal of artistic theory as well as a considerable amount of the history of recent New York painting. It could not have been art fifty years ago. But then there could not have been, everything being equal, flight insurance in the Middle Ages, or Etruscan typewriter erasers. The world has to be ready for certain things, the Artworld no less than the real one.

Danto is trying to explain, using philosophical terms, how Andy Warhol can get away with mimicking Brillo boxes in his artwork, and what makes a Warhol Brillo box command a much higher price than the real thing. It’s all about context.

Since Duchamp, an artist can put anything forward in the situation of an art world and no one will bat an eyelid. This is only because the gallery and museum have evolved to accommodate anything, ever since Walter Arensburg said no work would be refused from the infamous

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Armory Show. Duchamp took him at his word, and fifty years later Warhol went one step further, putting the products of Madison Avenue forward as the most worthy of artistic acceptance. The art world, so redefined, had no choice but to accept.

For Danto this is proof that what makes something art is not its intrinsic qualities but how it is situated and valued by the appreciators of art. Patting himself on the back, he says that this is exactly why artists need theories of art—not just critics who like and dislike, but thinkers who explain why something matters:

It is the role of artistic theories, these days as always, to make the artworld, and art, possible. It would, I should think, never have occurred to the painters of Lascaux that they were producing *art* on those walls. Not unless there were neolithic aestheticians. . . . Brillo boxes may reveal us to ourselves as well as anything might: as a mirror held up to nature, they might serve to catch the conscience of our kings.

So the artwork itself need not be sophisticated, or unsophisticated. What matters is what sophisticated thinking might arise from our encounter with the artwork.

This is what Prum gleans from Danto's take on Duchamp and Warhol: the nature of the work itself matters little. It really can be *anything*, as long as a coherent story has arisen about why the work should be appreciated, and a community of tastemakers and art lovers evolves to celebrate the work (or style) and promotes it strongly enough so that it will endure in society long enough to make a difference.

Thus the evolving art world has an interesting parallel with the aesthetic features of life as evolved by sexual selection. Prum adapts Danto's idea into a definition of art that just might work both for human culture and for biological evolution. Prum proposes that "art is a communication that evolves by coevolution between the observed and the observer, a performance and an audience, through sensory evaluation. Basically there are an extreme number of biotic art worlds that we are observing from the outside: a nightingale art world, a bowerbird art

world, a mockingbird art world. For humans we've got cubism, social realism, abstract expressionism, minimalism." Coevolution theory thus provides a framework for understanding art, in terms of how the trait to appreciate evolves with the making of the works. What are aesthetic values? "We gotta get over ourselves. We are not the center of life or the universe. Our culture is not the center of culture. There is a seamless interaction between coevolutionary theory and aesthetics."

From Arthur Danto's recent book *The Abuse of Beauty* Prum gleaned that philosophically, the end of art history means a liberation for artists to do whatever they want, which restores beauty to its rightful place. Now art is "what we like, what delights us."

And this is how human art worlds work as well: art is coevolution for evaluation. So what happens when *we* look at bird plumage or listen to bird song? Our human sensibilities have evolved with certain interactions: we've heard Mozart, we've seen Ansel Adams. We evolve human aesthetic ideas. When we enjoy a bird song, it's an *inter*-art world experience, like listening to Noh theater and not knowing the Japanese language—there's going to be some understanding, but the more culture is involved, the more likely there is to be *mis*understanding. "Ask people all over the world," suggests Prum, "What's more beautiful, a nightingale song or a nightingale begging call? Or compare Pollock and Peking opera. They're going to have an easier time agreeing about the bird song than about human art. The only way to satisfactorily define art is as a communication that is the result of a particular kind of evolutionary process. We're talking about the flower and the bee; we're talking about the brilliant colors of poisonous coral snakes. There's something about the aesthetic value that can be arbitrary: we see beauty, they see fear. Same with glistening poisonous dart frogs. It's art that leads birds and other potential predators to flee in fear."

What do we gain by calling these things art? "You gain because you've picked a definition of art that isn't centered on people." If birds have intention, then the natural world has meaning. If birds have culture, they create artifacts, and we have more levels of understanding to share with them. We may treat them with more respect; we might be much more likely to want to get to know them better.

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How important is the arbitrariness of natural aesthetics for Prum's coevolutionary idea? Danto was trying to come up with some philosophical justification for why it had become possible in the twentieth century to put forth even a tipped pisspot as art and have a century of artists and art lovers take it seriously. The object, he tells us, has been sidelined. The act of display matters more. We lived through a time when all dogmas have been questioned—the century cannot hold. Question everything! Danto applauds this. It turns art into philosophy.

I never quite trusted this conclusion, for, as a philosopher, I would rather turn philosophy into art. Make it more beautiful, evocative, wandering in beauty. Less logic, more poetry. Less argument, more dance. If the book you're reading is to work, it's got to have some of that danger, risk, and delight. So in a way I'm prejudiced against Danto: he writes too much about famous but somewhat bogus art. Duchamp is an easy target, and Denis Dutton leaped to the challenge. His recent book *The Art Instinct* is the result of spending many decades thinking about how the evolution of art is intrinsic to the evolution of the human species. Dutton argued that art is necessary for our place in this natural world, and that the right, best human art fits into our place in the environment as a species.

He too wants art to be beautiful and aesthetic, but he also wants it to be adaptive, useful, good for humans, because it is instinctually part of our makeup. But only *our* makeup. Not in animals, not in plants, not in the order of crystals or the sublime abyss of the heavens. Certain things about Duchamp's "Fountain" trouble Dutton, because they are missing from our experience of this work. First, it takes little skill or virtuosity to create the thing, as all Duchamp did was put it forward as a readymade, on a pedestal and tilted just so for the viewer's contemplation. Then there is little direct pleasure in viewing the object. The pleasure is more ironic, like a joke or a shaggy-dog story. It is not a thing saturated with emotion, something that encourages us to study it more deeply or spend time with it. It is nothing that encourages a profound imaginative experience. In other words, there just ain't much there. It trivializes Duchamp to overemphasize this work in his oeuvre, just as it trivializes John Cage to think of him only as the composer

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who wrote a piece that was 100 percent silence. It trivializes twentieth-century art to take this one work too seriously, as many artists I know do. When Duchamp himself was asked later in life about this famous work, he replied, “Please note that I didn’t want to make a work of art out of it.” Dutton asks, “Isn’t it high time to take Duchamp at his word?”

Richard Prum is not convinced. To him, Dutton is a man who has definitely drunk the Zahavi Kool-Aid. “Come on—Dutton doesn’t recognize any culture in birds, or even in people! If we really think about what we know about bird song, we would eliminate any definition of art as a human enterprise alone.” This is because it is the temptation for all who want to connect art to evolution to find evolutionary justification for why we humans seem to be wasting so much precious time on the creation and appreciation of things that seem, to some, biologically useless. How can this be? We value art so highly that it must be important to our very human essence, which means our biological makeup and the unique and unusual way human beings have adapted to our environment using our unique strategy of culture and technology to find our place in the biosphere.

Dutton applauds the relevance of sexual selection to explain why there is so much beauty in human life, but he is expressly uninterested in the aesthetic creations of animals such as bowerbirds, calling them unartistic because they occur with no sense of self-reflection or learned culture. They may look impressive to us because they are unusual in the realm of animals, but since birds don’t think about what they are doing, why bother calling them artists? It is rather curious that someone so interested in the evolutionary origins of art would employ such a philosophical sleight of hand to separate us from the rest of nature because we are able to analyze what it is we are doing.

But we have demonstrated that birds do possess intention before singing or display, says Prum. “Erich Jarvis has shown that birds have that—they *know* whom they’re singing to, they have intention, we have absolute mechanistic support that the bird is intending to sing, it is not a mechanical music box. How about meaning? I’ve argued against the importance of meaning in the peacock’s tail. But the red plumage of

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the house finch *may* mean *I'm better, I come from a better egg*. But just in the house finch, not in the cardinal.”

Could it also mean *I'm beautiful*?

When Dutton moves to apply biology to behavior, be it of animals or humans, he begins to explain away the self-criticism and creativity that is supposed to be so uniquely human. Following Zahavi, creating works of art should show that whoever is making them has the kind of serious resources that makes them a good potential mate.

“Total rubbish,” says Prum. “Just thinking about Dutton is enough to ruin your day.” It’s bad enough if scientists swallow Zahavi’s unproven, limiting theories, but now we have theorists of art glomming on to them too. And yet what is Prum offering as an alternative? Arbitrariness. Art as evolved through sexual selection is coevolution of the created and the appreciated, but anything at all could be selected for.

Look to animals, says Prum, for an understanding of what good and bad art could be. Each animal species has evolved its unique situation of performance/appearance by the males and appreciation/taste of the females. They know what’s good, what’s right, what’s necessary. They do not need to reflect on it or be self-aware of the situation, because they are inherently situated in the artistic midst. What ends up being selected for does start out arbitrary, but once it’s evolved, it’s as certain as if your descendants depended on it. And they do.

ONCE the extremely beautiful features of a species are established, aren’t they somehow fixed? Peacock tails don’t get bigger and bigger until the male birds can no longer move. Species aesthetics seem to become fixed somewhere along the way, and the males develop those traits the females appreciate—in appearance, in performance, and in those rare cases, in the artworks they build. But in many cases there is also learned behavior that is different in different groups, so animals are said to have culture (at least by those who don’t get overly protective of the term). How much of a reason do we need to find for this variation? Does it vary because it can, because evolution makes it possible, or because it is somehow necessary?

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What about those peacocks? Are all the tails the same? While Darwin said the peacock's tail made him pale with confusion, for Prum his field's tales of its meaning make him really angry: "I was looking at the peacock's tail and saying that I think it's arbitrary, and everyone else is thinking it's not. And I say, there are all these biological reasons, like there's no male perennial care, there's no opportunity of direct benefits beyond avoiding some disease, and there are too many dimensions of ornamentation for the tail to be explained. Because what these Zahavi models say is that every single handicap has to have an independent production of viability costs, corresponding dimensions of quality information. There just aren't that many."

Look at how little we know about human biology after decoding our own genome. Sure, it's a tremendous achievement, but it is no Rosetta Stone for everything. "If we can only explain 8 percent of the heart attacks with 100 percent of the genomic information, then how is the female peahen going to do better than that by just looking at her guy's tail? She's not. So to me that's what I describe as *merely* beautiful. Then people come to me and say, 'But Rick, that's nihilism. You're telling me shit doesn't matter.' And I'm going, 'Why do I see this as intrinsically meaningful, a fantastic scientific insight, and they see it as the end of their job? Why do I find so much enjoyment and meaning in my research, and they find my approach to be sterile?' I needed a new way to put it. That's when I started to think about beauty. What this means is that the peacock's tail is clearly beautiful, and beauty should be of interest to everybody, even if we are freakin' scientists.

"Then I started getting into the literature of beauty, and found that the literature of aesthetics provided no solace to my problem. And as I read I thought perhaps I have a solution to some of their problems. Art can be described as the coevolution of evaluation and its signal. So when you have feedback of either a cultural or genetic mechanism between the preferences for a stimulus and the stimulus itself, you create the same dynamics that the peacock's tail is one singular example of. Some others are fruit advertisement, floral advertisement, and sexual advertisement. This implies that aesthetics and biology of communication are potentially the same field. With humans, the

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culture component is turned way up and the genetic component is turned down. We are not alone in this: bowerbirds are like that too.”

Aesthetics and biology one and the same? I thought the latter was where we came from and the former was supposed to be all in the eyes of the beholder, at least at the species level. Is beauty there or is it a mirage? Coevolution makes it real, necessary, there. But *still* arbitrary? I ask Prum if there is bad art in the natural world.

“Most of those peacocks,” he says, “don’t ever get to mate.”

“Is that really true? What about that study that shows all the tails are basically the same size?”

“Ah,” he says with a smile. “Those were in captivity. The females took whoever was available. But in the wild, yes, in the *wild*, with peacocks, birds of paradise, manikins, there is strong competition among females for the best and the brightest males.” For almost all the males the females are out of their league. The female aesthetic is so clear that they *know* who the best boys are. So much for everyone getting his girl in the end. Maybe we really are better off being human.

“So most of those beautiful birds of paradise don’t look so spectacular, only a few?”

“Not spectacular enough. And that is where ideas of the good and the bad come from. Masterpieces can evolve because you have a process where the end result is very high achievement. This is intrinsic to certain art worlds—highly evolved forms of human artistic achievement, and extremely evolved birds.” For Prum these superbirds are artworks in themselves, rare and special, and can be compared to highly refined human genres of art—as opposed, he says, to country and western music, “where matching the preferred aesthetic is not that hard. There is an extraordinarily low standard of rejection.”

“Really?” I wonder. “And it is some of the most popular music in America. From the personal sexual selection standpoint, this is a fine kind of music that just might get you laid.”

“Connoisseurship is hard,” Prum says, and grins. “If you don’t really get into wine, you’ll be happy drinking Bud.” Animals don’t have this choice. Each species has evolved its own level of refinement. You are what you are. If we take this wild art/evolution analogy seriously,

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humans do have an unusual level of choice, that's why we will always have so many kinds of art.

"I try to establish how aesthetic process occurs," Prum goes on. "I try to say that the population of individuals that are producing and evaluating is the critical group in which this process occurs, with gene flow and subdivision by geography. Then I say, basically, inherently this process has a lot of randomness, but then there is the curious fact that bird songs sound beautiful to us—anyone can appreciate a wood thrush. We can't say what is beautiful outside of a specific art world, where we know how what works is transmitted from generation to generation as long as that art world is intact, as long as a species endures.

"Sometimes these art worlds converge. But that has to do with the properties of mind, which is a huge mystery. What the framework does is to compartmentalize those issues in a way that talks about things in a predictive way, how those kinds of generalizations are going to emerge from aesthetic process to give rise to things that are either beautiful or arcanelly weird. I think there is an area where so far there is no science. The scientific questions here lie in trying to understand the structure of these minds. The interesting prospect, this is somewhat spooky: if there are other intelligences on other planets, might they converge in the same way that bees and humans have on olfactory agreement on some aspects of beauty?"

I nod in agreement. I am entranced by this same mystery, of some common aesthetic different species may appreciate, somewhere defined by the fluid rules and tendencies of nature that make it all possible. It's too easy to say nature is the guide, nature is the key, nature is the one, the right, the pure, the ultimate. It's an old, vague idea everyone knows to be part true. But nature is also everything else that we don't like, that wears us down, kills us, destroys us. It's all those pure principles we will never completely know. But the parallels, the patterns, the excitement, the joy! Why these forms and not others? Laws of physics, chemistry, and mathematics may underlie it all, but life tests them out with the play of arbitrariness.

Arbitrary, accidental, nothing but chance . . . sexual selection can work upon anything, and both plain and ornate art worlds can be

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evolved. Is this not too easy? Does this end up taking no stand on aesthetic value whatsoever? Is it then wrong to call a Wilson's bird of paradise beautiful, with its dramatic curlicue tail and its single blue crest feather? Is a gray catbird not also beautiful, with its understated lines and color? Nature has both sublime minimalists and gaudy decorativists, but whatever species you're inside of, you haven't got all that much choice of what you're going to do or what you're going to like. In those animals with cultural variations in song dialect, plumage, or performance, you've got some, but usually individual expression is not rewarded. When you're inside the art world, it feels anything but arbitrary. The beauty of nature might mean no individual has to strive to be so different as to push the envelope of the species.

But somewhere that must happen sometime, else no species would ever become another. This is difficult, though, to see, unless you wait around and watch for a million years.

I decide to bring my friend and colleague Ofer Tchernichovski to visit Richard Prum at the Peabody Museum at Yale. Tchernichovski is one of my favorite bird song neuroscientists, described in *Why Birds Sing*, because instead of killing his zebra finches right after they sing to examine exactly what is lighting up inside their brains, he recorded every single sound the baby finches made while learning to sing, during their three-month sensitive learning period. This way he has an amazing record of how the birds learn the very specific patterns that are meaningful to them: How they learn a piece of the song, how they forget a bit. How they fall asleep right after they get a new sound. How the whole song crystallizes. Which patterns matter most. Tchernichovski is also not a strict adaptationist. He doesn't believe everything evolves for the greatest optimization of something. He studied in Israel and remembers Zahavi well.

"Zahavi, he is a very convincing guy for an undergraduate. One of the things I remember very well, we were studying stalking behavior in the gazelle. When they see you they turn their butts towards you, wiggle their tail, jump up and down a few times, then run away. Take

just pure logic. Say you are a deer and you have very strong abilities, strong muscles, in good shape, you have seen the predator. The issue is telling the predator, ‘Here I am, here I am!’ which is what they do, basically—then it makes a lot of sense. You can describe the round muscles—the color pattern emphasizes that—and he is jumping up and down. You can immediately get the idea that you can’t catch that guy. But if you jump badly, then the most stupid thing you can do is tell the lion, ‘Here I am, here I am.’ Everything is supposed to be designed in a way that will immediately expose your weakness, which is why this communication evolved to begin with! From the beginning the predator can derive meaningful information—it’s only because of the handicap. So the logic is perfect! But there’s one problem . . . Zahavi is all theory.” He has no data at all for this whole just-so story.

This is a side of science that seems much more like faith: there must be a practical reason for all biological phenomena that seem striking, curious, or beautiful. Our explanation should not be *no* explanation. Tchernichovski says to me, “I am actually on your side, as I do believe that perhaps 90 percent or more of what we see is not adaptive, not functional, not anything.”

“I’m not saying the emperor wears no clothes,” Prum answers cryptically. “I am saying that the emperor is wearing a loincloth. And my prediction is that the naughty bits under the loincloth constitute about the proportion of total intersexual signals that are covered by the adaptive signaling hypothesis. And the vast majority of the details are actually undescribed. Because people have a faith that their mission is to confirm their own personal feelings of meaning in nature by discovering the single explanation by natural selection. What I think happened is that whole generation had this unbelievable buzz—like, ‘Wow, the power of natural selection’—that reinforced the adaptationist argument.” The adaptationist framework led to sociobiology. Ethology, the study of animal behavior, was pushed to the sidelines, because with the handicap hypothesis we had such an elegant example of the power of natural selection to incorporate things that were currently outside of explanation into natural selection. “Zahavi was on the outside, raving in the wilderness, until people started to take female choice seriously

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when this math was invented. Then they suddenly realized that can work, but what to do with arbitrariness? Zahavi saves us from doubt; he folds all this diversity back into meaning. And I think there is a deep-seated need among certain intellectual types for the world to be meaningful.”

Tchernichovski doesn't like this. “We are beating a dead horse in a sense. Zahavi operates *totally without data*. What else have you got? So all these natural features are arbitrary, so what?”

Prum laughs. “Why is arbitrary interesting? I think that it is fundamentally interesting that genetic variation itself has incredible consequences. I think the consequences in particular have to do when genetic variation becomes correlated with genetic evaluation. And that in and of itself is intrinsic to the feedback between preference and trait, creating a dynamic process that gives rise to what I describe as art and beauty in nature. The feedback between male and female that evolves through sexual, not natural, selection, gives life this quality.”

Isn't some of what appears characteristic of the forms in nature made possible by math and physics, challenging the arbitrary with some sense of absolute, those patterns of order revealed by Ernst Haeckel and D'Arcy Thompson?

Tchernichovski says: “I completely agree. And one thing this reminds me of, in my own history, is when I went to Ilan Golani's lab—he was my mentor in Tel Aviv—he thought about all these ideas maybe twenty-five or thirty years ago and developed them quite a bit beyond the level of what you talk about now. He was working on movement. He was using rats, how they moved around a maze. We were working under the assumption that everything is like 90 percent arbitrary, but that's not the point. The point is the beauty of the behavior, studying from basic principles. And we were hoping that physics would give us this. Actually your work on feathers sort of touched a nerve in me, because you were implementing such ideas when you looked at how feathers form and the specific ways they produce color.”

Prum: “What's fascinating and a special case of sexual selection and art in general is that in the case of the feather, in the case of the body plan, in the case of development, the substrate that determines

function is the physical world; the feather either functions or it doesn't. They evolved that way, they were unconstrained in that way. But what is unique about sexual selection is that the function substrate of the communication is *in the brain of another individual*. Female choice is what decides—that is an unconstrained place that gives rise to new dynamics where the functional target is not just crawling, walking, running. The functional target, as Darwin said, is delight. *Delight!*"

The world is beautiful, and it is loved.

Tchernichovski is a bit skeptical: "What you are doing is saying our brain is designed and the world is designed, so life is guided by constraints. And some of those constraints might be universal. This can only become science when you have the ability to say those are the actual constraints in the brain's interactions with the real world. Can you tell me why bird songs sound beautiful to us, and answer using the methods of science?"

"In music and sound it is almost trivial, because the physics of harmony is so overt and so obvious," says Prum.

"So is a bird going to hear an octave as an octave?" I asked. I never did get a straight answer to this question in all my research into it.

"Absolutely." Prum, at least, is sure. "The fact that they even hear octaves or thirds or other sorts of harmonic steps and that those are statistically distributed in songs that have pure tone components is an unbelievable confirmation of the aesthetic hypothesis. We have marvelous support for the aesthetic hypothesis that is staring right at us. Yet we see this as trivial. I have already defined aesthetics as the process of coevolution of the work with its evaluation that occurs in an art world. You're asking for the biases that go into actually determining what the content of that is. Plenty of bird songs are ugly. The Henslow sparrow has a repertoire of one song: it goes *slick slick slick*. What's unusual is that its ancestors had a much more complicated repertoire and complicated acoustic content, but over evolutionary time it has become simplified. It is a precise product of aesthetic process, demonstrating the arbitrariness of the sexually selected direction. This song got simpler, while others get more complex. It could go any which way . . . that's how aesthetics works."

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Tchernichovski gets agitated. “You can’t do this! You can’t! It is completely religious, what you are doing, no better than Dawkins and Dutton drunk on adaptive explanations for everything! All you have is faith in your approach.”

“Not faith, but philosophy,” Prum says, defending himself. “I’m thinking through how to demonstrate that art can evolve right out there in nature.”

Tchernichovski finds Prum’s direction circular to the point of proving nothing, and he only gets angrier, shouting, “This argument that song is complex in order not to be boring, to me this *argument* is boring. Who gives a shit about arbitrariness if it gets you nowhere?”

The problem with Prum, Tchernichovski later confides to me, is that he is just proposing theories, thinking like a philosopher, which approaches Zahavi in one dangerous direction, toward “operating totally without data.” Is that what philosophers do? All of us concerned with such topics are caught in paradoxes. I believe art makes us more attentive to the world around us, that it really helps us conceive of a world with more purpose and definite meaning. This is a hunch, but I can document it through history. I can demonstrate the value of an aesthetic view, and others have done so before. It has been hard to find scientists who are sympathetic to his view, but now we’ve got two in the same room.

Do they disagree? As a biologist, Prum believes that through his idea of coevolution he can revolutionize aesthetics, a field that most of philosophy, and most of art, tends to shy away from. No creative person seems happy distinguishing the good from the bad from the ugly. We do not want rules or pronouncements. Looking to biology for the rules for beauty seems inherently conservative, the opposite of Duchamp and Danto, who prove that anything can be put forward as art if a sufficient number of people are game enough to talk about it. But these are extremes, and they may make bad examples. I am more interested in how art leads us to see more in the natural world around us, how it is one more part of human experience that makes the world we have evolved in seem ever more meaningful and important.

How do we find out which is good art and which is bad? Good art

is certainly not the art that the greatest number of people like, which would be the obvious choice for some devotees of the sexual selection theory of art. I wonder if Prum's model will really hold up to statistical scrutiny. So I ask him, "How far can you carry this sexually selected coevolution model to explain human art? The most advanced human art worlds are not the ones with the widest audience. Following a coevolution model, wouldn't the biggest pop stars be the best musicians, because a larger part of the population is impressed by them?"

He laughs. "That is like saying that just because I can memorize 'There once was a whore from Nantucket,' somehow limericks are better than sonnets or blank verse, because they worm their way into your brain. In fact, the most popular art worlds are usually art worlds where the aesthetic requirements of participation are really low—in birds with a low amount of sexual selection, where every male gets a mate and raises young, the songs are not that complicated compared to, say, a lyrebird, where there is large polygamy. And bowerbirds have more complicated plumage than thrushes because their sexual selection is stronger. In advanced art worlds, most art is going to *fail*. It is no accident that most peacocks don't get to mate. They are different enough for females to prefer one to the other. In other words, the fact that most opera sucks is an indication of how hard it is to do it well. But when you fulfill those aesthetic criteria for success, you have the potential for a true masterpiece, something that endures for centuries. Whereas a country and western song or a rap song, the aesthetic level for success is much lower."

"But wait a minute, some of these songs endure for centuries. Many of them."

"Well we haven't centuries enough—"

"To forget the Beatles? People have been singing 'Amazing Grace' and 'Yankee Doodle' for quite a while. When asked to sing the oldest song they knew, the pygmies in the Ituri Forest sang 'Clementine.' These songs are not going away. Meme or earworm, we're stuck with them."

Prum goes on: "I am saying there are explicit variations between art worlds—in the likelihood of success, the strength of preference, and

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selection—that have predictive consequences for aesthetic success. Most poetry sucks, because poetry is hard! That means something very powerful about the poetic art world survives its coevolution with critical scrutiny. That stringing together of random words or obsequious little terms that rhyme at the end is not enough. In country and western music the aesthetic criteria for success are a lot easier. This is something that distinguishes low art from high art. I would use *low* and *high* purposefully and with an ability to define them. Because if you have something that has an incredibly specific aesthetic criterion for success, it is going to become a high art, even if it is something like graffiti.”

So are some animals higher artists by their very nature?

“Some birds are objectively higher artists than others. There are going to be a lot more aesthetic papers on mockingbird song than on the Henslow sparrow’s *cheep*.” Of course, there are hardly any written on either, because biology doesn’t value aesthetics highly enough. There are only papers on zebra finches and canaries, because those are the model species whose genomes have been sequenced. There are very few papers on the most aesthetic of birds, even bowerbirds, which are such amazing artists, and birds of paradise, whose bodies themselves are feathery sculptures of color and light. Scientists seem to not know what to say in the face of such beauty, or even what questions to ask. Yet until science changes its tune, we will miss much of what is important about nature’s ways.

Some people have tried to say that only human art is intended to mean something. But what does that fugue by Bach mean? It means the same way a bird song means. Bird song, bird sculpture, and even bird plumage is thus an art with its own criterion for success. You can’t easily translate it into anything else. It is only better or worse inside the context of female appreciation for the trait, which has evolved together with the trait in a logic that makes sense only within the species-specific, closed art world.

But is Prum really comfortable taking the beauty of the artwork and focusing on the gesture and whether or not the audience will be taken in by it? Damien Hirst can put a shark in formaldehyde in a big

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tank, and someone has paid \$12 million for this. After that, all these fisherman are saying, “Look, I got a shark here! Do you want to preserve my shark? It will cost you a lot less,” and no one is interested. It’s not the beauty or possible sublimity of the pickled shark that matters; it matters who has done it and what his acts of outrageousness are worth. For the small number of people able to afford a Damien Hirst, the very fact of its expense is what matters. The collector who bought it is saying, “Pssh! Merely \$12 million! That’s nothing to me—I could buy twelve more.” Art with an uncertain long-term value and possibly highly inflated current price is meant for those who have so much money that the investment value of the purchase matters less than its outrageousness. Are they the birds of paradise of the art scene?

“I would defend the purchase of a stuffed shark for \$12 million, or the urinal in the armory, because at various points these works were making strong intellectual and creative points,” says Prum. “But the difference between these two cases is that Duchamp was making a point about an exhibition that pledged to accept *all* entries; they couldn’t refuse his urinal, and so the history of art was changed. The stuffed shark is made in a different period, where art by a few star artists is now superexpensive, going for much more than anyone thinks the work will be worth in the long term. It’s important for the buyer of this work to prove he has so much money that it doesn’t matter to him whether it’s a good investment or not. It kind of plays into Zahavi or Dutton: my ungainly stuffed shark that fills the living room is no major handicap, because I’ve got ten houses all over the world waiting to be filled with shocking cutting-edge art. Doesn’t matter if you think it’s ridiculous, because *you* can’t afford it.”

IT is while watching Prum thumb through the field guide to South American birds that I finally understand why he is so drawn to aesthetics.

“Look at these toucans!” He points excitedly. “There is one clade of yelping toucans, and there’s another clade of croaking toucans. It turns out there are independent radiations. These guys are the yelpers

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Fig. 12. Richard Prum explaining the birds.

and these guys are the croakers; these are the models and these are the mimics. My hypothesis is that the smaller species is evolving to converge on the larger species, to take advantage of its social behavior. Imagine there's enough ecological similarity between the species that the big one has a reason to repel the smaller one. For the larger species, there is some ecological cost to the presence of a smaller species; they are also gamed by the smaller species when the smaller is not repelled.

“If we encounter each other at two feet in the hallway, you know exactly how big you are relatively. In a nasty bar, if you're on the way to the bathroom and bump into somebody face-to-face, you know exactly how big the other guy is. But if you encounter somebody at twenty or fifty meters away, you are much less likely to be so sure. Just like the seventh grader walking home from middle school will try to look tough so that he is mistaken at a block's distance for a high schooler—so that he doesn't get his ass beat.

“We see the same thing in this North American field guide. You know, the downy woodpecker and the hairy woodpecker look similar,

only one is bigger. What's interesting is that they're not so closely related as species. The downy woodpecker has evolved to converge upon the dominant larger species, so that the larger species at certain distances will mistake it for itself and thereby overestimate the cost of aggression." It's game theory at work in evolutionary challenges, but it plays itself out in aesthetics, one species evolving to disguise itself for another at certain moments in its life encounters.

These kind of game theory explanations sound like adaptationist thinking to me. What happened to arbitrariness? What is arbitrary is that these particular odd solutions didn't *have* to happen. They existed among the many possible evolutionary strategies. A blend of necessity and random invention made them come to pass. Aesthetics is not in the service of practicality; rather, it's one aspect of evolving diversity that might end up helpful or might end up ridiculous. But a strange trait still might survive against all odds even if it seems totally frivolous and nonengineered.

Prum flips further through the bird book's pages, finding all kinds of relationships that the average reader might easily miss. "Look at this ornate hawk eagle, a big boss—he's an orangey guy. Here is a smaller accipiter, the South American goshawk. That's the juvenile, absolutely convergent with the ornate hawk eagle, and this is clearly going on for some kind of aesthetic reason—sexual pairing, looking cool so they can mate with each other. This is a guy who is gaming the system. Just like a real stable forgery should be rare. All these things about authenticity and rarity and forgery have been going on in all of these art systems forever."

"Wouldn't you say there are certain principles behind how the plumage is all arranged? It's *not* true that anything could happen."

"When you knit a sweater, knit one and purl two is easy. Cables, that is really easy. But paisley, forget it—it's really hard. In the same way, feathers have things that are easy to do at the level of the feather; at the level of the plumage, there are things that are very accessible variations, and there are variations that are very difficult to access."

"What is the most difficult feather?" I ask.

"Well, there are impossible feathers. And there are ones that still

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defy our explanations, such as Darwin's favorite, the Argus pheasant. We can't explain him. For the peacock we have an explanation at multiple levels. We have a loose hypothesis that needs testing. We've simulated them with easy math, and we can get a circle or a concentric set of circles like the peacock."

Over the years since he lost the acuteness of his hearing, Richard Prum has not turned away from a love for the beauty of birds and a belief that this beauty can be figured out. Are the feathers on birds the result of arbitrary preference over generations of coevolved aesthetic chances and preferences? Actually, it is not completely arbitrary by any means. Prum tells me he is one of few scientists who is "actively engaged in D'Arcy Thompson's research program." What he means is he is trying to quantify the morphology of an aspect of nature using rigorous mathematical means. How do feather patterns happen? The growth and color of feathers are extremely complex, even at the level of a single feather, not to mention the complex of feathers that colors the entire bird. At the level of the single feather, there is a vast range of possibilities, but could their appearance really be almost anything? Figure 13 illustrates a sampling of the basic pattern forms nature makes possible.

It is not hard to look at these and realize there are certain kinds of patterns that appear, and many possibilities one could imagine that never appear. Using reaction-diffusion equations first modeled by the great mathematician Alan Turing in the 1950s, Prum and his colleague Scott Williamson were able to model mathematically six variables of feather growth, and then come up with nine basic kinds of feather patterns producible by activator and inhibitor chemicals.

This is the same mathematical approach proposed by Turing in 1952 to explain convincingly why animals with patterned pelts usually have versions of lines or stripes, based on the number of nodes in the chemical system that turn pigmentation on and off in the cells that make up the molecular structure of the animal as it develops from its most incipient form. He called this a reaction-diffusion system. Subsequent development of Turing's idea using more precise genetics led mathematical biologist Hans Meinhardt to convincingly explain in 1972 why it is that animal skins tend to have patterns that are either lines, circles,

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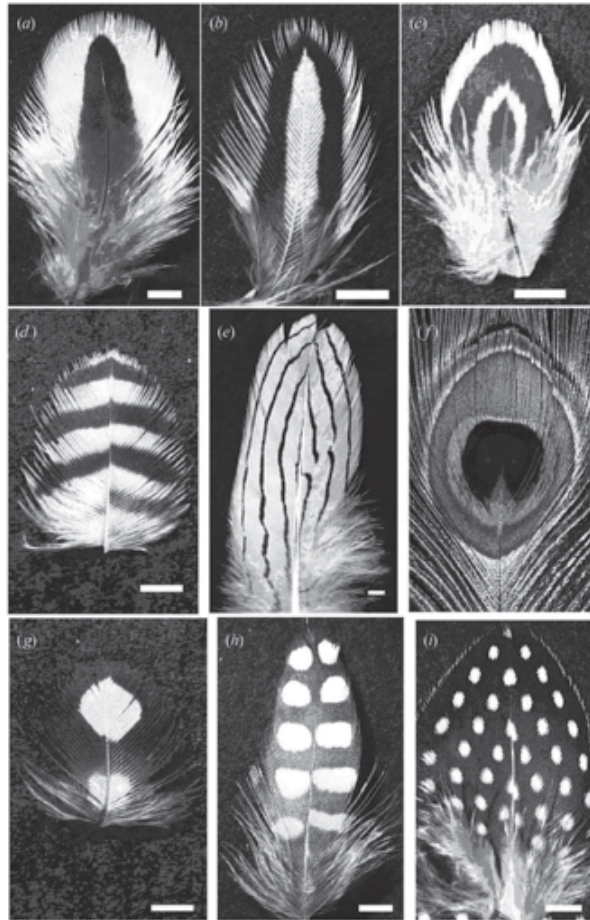


Fig. 13. Richard Prum’s basic feather types.

or spots. The mechanism was now clarified as an “activator-inhibitor scheme.”

Using equations “that I don’t even understand completely,” says Prum (making me feel a little more at ease), he and Williamson were able to tweak a series of six variables to produce a series of possible feathers that model quite effectively the range of what is out there. They also came up with two possible feathers that don’t seem to exist in nature. Are there feathers not accounted for by their model? “We still haven’t figured out Darwin’s beloved Argus pheasant,” he admits.

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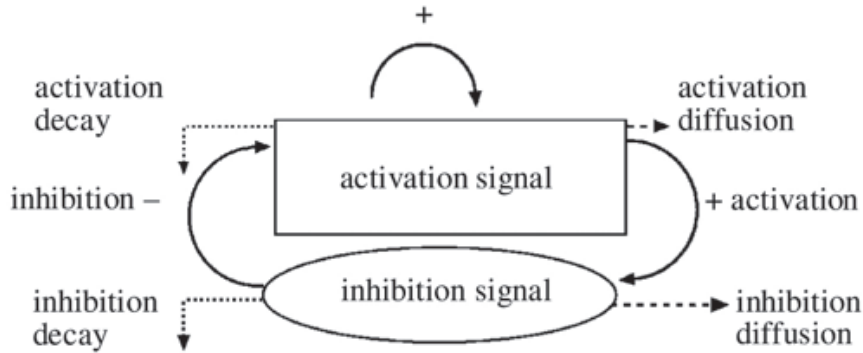


Fig. 14. Richard Prum's activation/inhibition model, based on Alan Turing.

This magnificent feat of genetic analysis and mathematical modeling has profound aesthetic implications. These are the possible patterns; so are they then the beautiful patterns? If these are the forms that nature makes possible, then should we consider that something is more beautiful about these results than those that are impossible?

The simplest pigment pattern in a feather is a central patch of color, easily simulatable with differential rates of diffusion in activating and inhibiting protein signals. Different diffusion rates and scales can simulate a series of concentric central patches, and then barred feather patterns, simply by adjusting the numbers of the mathematical variables. More complex patterns require simultaneous differentiation over both space and time, such as the famous eyespot in a peacock feather. There are other patterns the team first found mathematically and only then noticed in the real world—for example, a double spot pattern that their equations predicted, but which they only later realized appeared in the feathers of the greater flameback woodpecker of Indonesia, a most impressive bird.

So can one produce a model like this and still say the appearance of sexually selected traits is arbitrary? Prum would qualify and say that within this realm of mathematical possibilities, the arbitrariness sets in. To me this suggests that there are absolute senses of aesthetics, located right here in this mathematics. It is the legacy of Haeckel and D'Arcy Thompson melding with the advances of a century of genetics.

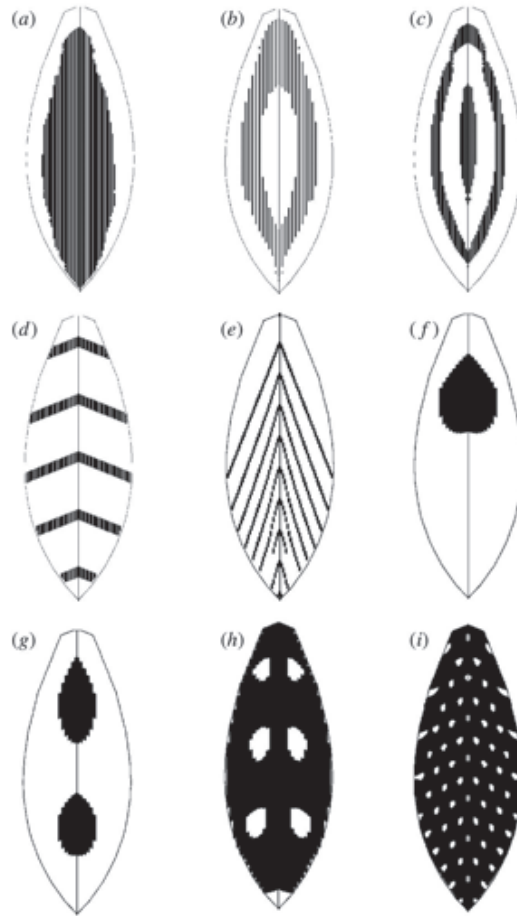


Fig. 15. A diagram of Richard Prum's basic feather types.

We are learning ever more about how specific genetic information in single cells makes possible the whole development of feather patterns in birds and coloration and form in other living things. Of course, there is more focus on how form develops than on why certain forms exist and not others, because predictive power is much stronger for mechanisms than for aesthetic choice. But those choices are made somewhere in the system. Is it not a cop-out to say it is all arbitrary? Pushing arbitrariness too much denies the relevance of all this feather modeling to the whole aesthetics story.

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Remember, this is still only one of many processes that evolution uses. You can look at evolution and see its results as a makeshift, haphazard assembly of all these possible methods, which rarely use the simplest or most elegant solution to any problem of an organism finding its place in the environment. That is the view of Gary Marcus, professor of psychology at New York University: “One thing that people, even scientists, frequently forget is that because evolution is not planned in advance, its end products aren’t necessarily elegant or optimal.” Marcus is the author of *Kluge: The Haphazard Construction of the Human Mind*, which argues that much of the way our brains are put together is, as Prum might concur, the result of arbitrary and messy developments in evolution, with no easy system holding it all together. He concludes that much of what nature has wrought has the same makeshift quality:

“When you look more carefully at the actual biology, at what genes are expressed, when and how, nature often just misses the boat. A good example of this is the dozen or so alternating ‘stripes’ that you see early in fruit fly development. For years, mathematicians and computer scientists had been showing you could build the whole schmear using Turing’s elegant reaction-diffusion mathematics. But even though the computer models seemed impeccable, nature just doesn’t build the fly that way; instead, it turns out that each of the fly’s stripes is coded for by a different combination of genes. What seemed elegant on the outside is actually hard-coded internally a really clumsy way. Natural selection is a *meliorizer*, a process that makes things better, not an *optimizer*, which makes things as good as they could conceivably be.”

So even natural selection, not only sexual selection, owes a lot to random mutation and arbitrary directions to set up the evolution of solutions. We must blend elegance with happenstance.

Still, I am sympathetic with Prum’s desire to liberate aesthetics from adaptive explanations. If sexual selection can go any which way, from plain brown to riotous color, dependent on the course each species has taken, then one could say there are no rules. But when it comes to feathers, it is clear there are certain constraints, certain ways nature has turned out to be because of the mathematics that guides our world.



Fig. 16. *Anchiornis huxleyi*, the first dinosaur whose real colors we have discovered.

Using the same understanding of how pattern, expressed in feather color and shape, develops cellular genetic information, Prum has done what many would consider impossible: accurately demonstrate what color feathers a fossil dinosaur had, ending more than a century of speculative reconstruction of dinosaur color based on wishful thinking and humanly impressive aesthetics. With the genetic techniques he has pioneered, in 2010 Prum and a team of researchers was able, for the first time, to accurately depict the color of one very interesting-looking prehistoric beast, *Anchiornis huxleyi*, who lived more than 150 million years ago.

So at last we can answer the question that has gripped us for so long: which came first, the feather or the bird?

Being able to reconstruct plumage and pattern of a creature whose feathers have been decayed into dust for millions of years before humans ever appeared to marvel at them is truly an amazing development. With such impressive recent successes in science, perhaps his radical views on sexual selection might gain some wider acceptance.

“Is science going to appreciate your sidetrack into aesthetics?”
I ask.

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He smiles. “No, I think it’s going to make me look like a lunatic. Except I think it will broadly contribute to the structuralist alternative to the extreme adaptationist direction that is building across evo-devo, genetics, and the biological component of pattern formation and the social behavior of signaling. One of my goals is to try and create a non-adaptationist interconnection between evolutionary biology and the rest of the world, in particular academia. We skip right over Dawkins and Dennett and we create our own channel, where our field is no longer being represented by merely one set of voices.

“Darwin showed a breadth that I think none of the Darwinians around today show. He took the limitations of his explanations seriously and then invented a whole new theory that explained what was happening outside of natural selection, unconstrained by natural selection. And he was right on, and that led straight up to the connection between aesthetics and sexual selection. So when people say ‘Darwinian’ today, especially in regard to sexual signaling, they really mean Wallacian, which is, ‘Oh, yeah, sexual selection is happening, but it’s constrained entirely and will give dynamics that are totally identical to natural selection because it’s totally determined by natural selection.’

“If we can get the humanities to understand that evolutionary biology is not about form and function exclusively, but about historicity, development, and structure, these are exactly the kinds of concerns that somebody who studies Dickens should have. What was Dickens like as a boy and how did that affect his work? Basically about the same thing. Not about, ‘Oh, Dickens wrote this book so he could have more money so he could attract hotter chicks and have more fitness.’ That is a nonexplanation of his output. It’s ridiculous for literature, and it’s as ridiculous for life itself!”

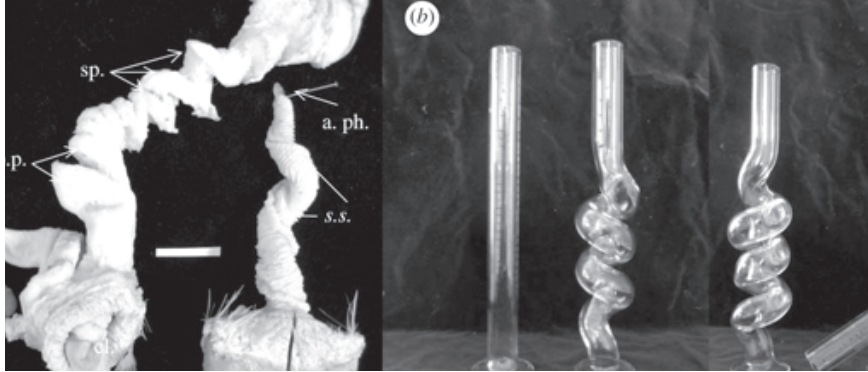
Prum is so enthused about how artistic the world of evolution can seem that he wonders if he might go even further, to ponder whether sex itself could be considered art. “Because I am trying to basically get people to think, ‘Okay, sexual selection is like art, it has the same process.’ But that doesn’t mean that all of art is about sex, since that doesn’t lead to the actual engagement with the content of art and its

evolution. So do beautiful people have greater sexual pleasure than ugly people? To me the answer is no. Now, one may lust after whomever, but the very fact that a larger audience of people would think that the people involved in the sex act are actually lovely or attractive to a greater number of people does not speak to the quality of the sexual experience of those people. All the broken marriages in Hollywood support the view that a lot of beautiful people have really shitty experiences—it is kind of related to this aesthetic question. We are constrained by our biology, in terms of sex, *but also in terms of art*. Until the ear actually evolves, we have a certain standard set of potential harmonic capacities to appreciate sound. My ear is the same as the caveman's ear, at least until I got my viruses.”

If different bird species have different art worlds of various complexity, they also have different sexworlds, none more elaborate than the convoluted shapes of the Pekin duck penis and its intended Pekin duck vagina. You might think we are way off topic here, but consider this experiment of Prum and his colleagues Patricia Brennan and Christopher Clark to demonstrate how the female's genitalia has evolved to make copulation especially difficult, not easy, for the corkscrew-like penis to make its way in. I couldn't describe it better than their own abstract:

The functional morphology of the waterfowl penis and the mechanics of copulation in waterfowl . . . are poorly understood. We used high-speed video of phallus eversion and histology to describe for the first time the functional morphology of the avian penis. Eversion of the 20 centimeter muscovy duck penis is explosive, taking an average of 0.36 s[econds], and achieving a maximum velocity of 1.6 [meters per second]. . . . To test the hypothesis that female genital novelties make intromission difficult during forced copulations, we investigated penile eversion into glass tubes that presented different mechanical challenges to eversion. Eversion occurred successfully in a straight tube and a counterclockwise spiral tube that matched the chirality of the waterfowl penis, but eversion was significantly less

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*Fig. 17. Duck genitalia and mechanical barriers. (a) Male and female genitalia in a Pekin duck (*Anas sp.*). The phallus (right) spirals in a counterclockwise direction and the oviduct (left) spirals in a clockwise direction. The vagina has blind pouches (b.p.) proximal to the cloacal entrance, followed by a series of spirals (sp.). s.s, sulcus spermaticus; a. ph., tip of the penis; cl., cloaca. Scale bar, 2 cm. (b) Diameter glass tubes (10 mm) of different shapes used to test penis eversion; from left to right, straight, counterclockwise (male-like), clockwise, and 135° bend (female-like).*

successful into glass tubes with a clockwise spiral or a 135° bend, which mimicked female vaginal geometry. Our results support the hypothesis that duck vaginal complexity functions to exclude the penis during forced copulations, and has coevolved with the waterfowl penis via antagonistic sexual conflict.

So coevolution of male and female is more than taste and appreciation—we shouldn't forget convolution and struggle! I can only imagine how Duchamp would have smiled to see the tools of Prum's investigation this time.

Let's see which juried exhibit of contemporary art would accept this project. (Plenty of them!) I even sense a strand where Prum has learned from the world of art in enjoying the surrealistically absurd aspect of this grand investigation. Here is a man dedicated to revealing the obscure, the shocking, the surprising, the beautiful, all as some-

thing that we just might one day explain and have something rational to say about. The surrealism of science as it revels in the delight in just how magnificently weird nature can be—he out-Duchamps Duchamp! And yet behind it all there is a mission, a critique, and anger at all those in his field who are trying to imagine nature as too practical, too adaptively designed, too methodically *boring*, really, and forgetting beauty, forgetting delight. He wants to get to the bottom of all this, and believes science can truly progress at helping to explain the how and why of the art and wonder that the plethora of life truly is.

Can there ever be such progress in aesthetics itself?

“Well, I am hoping to make some,” says Prum. “Let’s put it this way. You play the clarinet, right? Think of Adolph Sax’s 1869 adjustment of the shape and position of the E-flat key—that was progress, no? Same with the paintbrush—now there are new materials that help us paint in certain ways. And the invention of photography created a whole new art.” Yes, yes, certainly there is progress in technology, and in the tools used to make art. But in our sense of what is good and bad, better or worse, have we advanced? One would hope that as we amass ever more information on the patterns and beauty possible in nature, and those chosen by evolution in nature, we may increase in our ability to appreciate all of what we discover, to organize it, to make sense of it, to hold it all in our heads.

Does the history of human art in the twentieth century hold up to Prum’s analysis as “coevolution of the work and its appreciation”? Does this analysis shed any light on art’s recent development? Even art that appears to be abstract has much to do with nature, and if such art succeeds, it will change the way nature appears, and even our view of evolution itself.