RANDOM HOUSE eBOOKS

Life's Grandeur

Stephen Jay Gould

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About the Book

In his characteristically iconoclastic and original way, Stephen Jay Gould argues that progress and increasing complexity are not inevitable features of the evolution of life on Earth. Further, if we wish to see grandeur in life, we must discard our selfish and anthropocentric view of evolution and learn to see it as Darwin did, as the random but unfathomably rich source of 'endless forms most beautiful and wonderful'. Any rational view of nature tells us that we are a simple branch on an immense bush; and that life on Earth is remarkable not for where it is leading, but for the fullness and constancy of its variety, ingenuity and diversity.

About the Author

Stephen Jay Gould (1941–2002) was the author of more than twenty books and wrote 300 consecutive columns for *Natural History*. He received the National Book Award for *Wonderful Life*, the National Book Critics Circle Award for *The Mismeasure of Man*, and an early MacArthur fellowship. For more than thirty years he taught geology, biology, and the history of science at Harvard University.

ALSO BY STEPHEN JAY GOULD

Ontogeny and Phylogeny
Ever Since Darwin
The Panda's Thumb
The Mismeasure of Man
Hen's Teeth and Horse's Toes
The Flamingo's Smile
An Urchin in the Storm
Time's Arrow, Time's Cycle
Illuminations (with R. W. Purcell)
Wonderful Life
Bully for Brontosaurus
Finders, Keepers (with R. W. Purcell)
Eight Little Piggies
Dinosaur in a Haystack
Questioning the Millennium
Leonardo's Mountain of Clams and the Diet of Worms
Rocks of Ages
The Lying Stones of Marrakech
Crossing Over (with R. W. Purcell)
I Have Landed
The Hedgehog, the Fox and the Magister's Pox
Triumph and Tragedy in Mudville

Life's Grandeur

The Spread of Excellence from Plato to Darwin

Stephen Jay Gould

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"Mosasaurus Ruled the Waves When They Rolled Over Western Kansas," by Charles R. Knight. Courtesy of the National Geographic Society Image Collection.

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For Rhonda,

who is the embodiment of excellence

• • •

Das Ewig – Weibliche

zieht uns hinan

• *A Baseball Primer for British Readers* •

IN OUR INCREASINGLY fragmented and parochial world, few phenomena other than global wars, pandemic diseases, and the Olympic Games bring us all together for common purposes. This book, written from an American parish, uses baseball—the quintessential shibboleth of my culture—as one of two central examples to carry the major message. This strategy may be terrific for Yanks, but what a turnoff for Brits! (I'd be truly pissed off if Stephen Hawking based his next book on grasping an analogy between the structure of the universe and hitting for six, bowling a maiden over, or being out leg before wicket.) Consequently, I hasten to provide this synopsis of an arcane American religion. (Baseball, of course, is so deep, so rich, and so subtle that this meagre effort can only be as absurd as a ten-page, easy-reading, comic book version of the *Summa Theologica*. But, as they say, once more unto the breach . . . .)

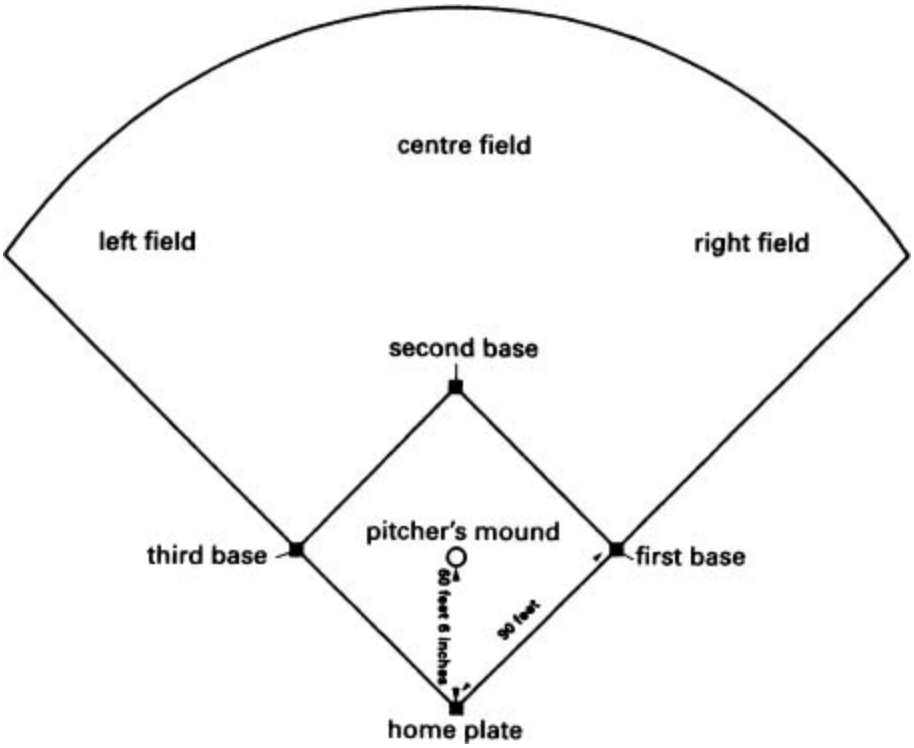
America is too young for mythic heroes. We have no distant King Arthurs, and must therefore invest our legends in real people who slay British tyrants (George Washington), free slaves (Abraham Lincoln), or emerge from an orphanage to hit sixty home runs in a single season (Babe Ruth). Baseball, a genuine sport that must also serve double duty (in this context) as a primal mythic institution, evolved in nineteenth-century America from various English stick-and-ball games (Jane Austen mentions something called "base ball" in a late eighteenth-century novel). One of our two modern professional leagues began in 1876, the other in 1901. Baseball gains its mythic and ecumenical status (within American culture) by virtue of its age and its original constitution as a pastime for all people, centred in rural and industrial urban life (whereas American football began in universities at a time when few people pursued

tertiary education, while basketball arose a good deal later and remained, until recently, a more restricted and largely indoor sport).

Two other peculiarities of baseball's history and structure abet the mythology and make such writings as Part Three of this book possible. First, baseball has experienced no major change of rules since 1893. Thus, events of a distant past are truly comprehensible and comparable with modern accomplishments. Second, although baseball is a team sport, each major action is a contest between individuals (pitcher against batter, runner against fielder, etc.). Consequently, statistics for personal performance have clear meaning and comparability (whereas passes attempted in football, or points scored in basketball, depend so crucially upon a team's overall strategy that we cannot meaningfully compare individual performances across teams and times). The lore of baseball is therefore awash in statistics. Any serious fan can tell you how many homers the Babe hit in 1927, how many games Cy Young won during his career, and how many ribbies that little stump of a man, Hack Wilson at five feet six, got in 1930. Such arcana immediately pose an insurmountable problem in translation. I can tell you the basic rules of the game in a few pages, but I can't transmit the lore —for this kind of "feel" requires a lifetime of involvement. Thus, you may end up understanding the points I raise in Part Three, but still be absolutely and utterly mystified as to why anyone would ever give a sliver of damn. Here I can only preach tolerance for national idiosyncracy. I am equally befuddled as to why a chorus of ecstacy should accompany the report that W. G. Grace, in his last match at age sixty-six, scored sixty-nine not out for Eltham. But I do accept that this is important—and I would as soon disparage this figure as I would tell Jesus or John the Baptist to get a shave and change clothes.

A baseball field (see accompanying diagram) has a diamond-shape infield with four bases at the corners, and a wedge-shaped outfield beyond. Balls hit into the wedge and beyond are "fair" and in play; balls hit to the side are "foul" and not in play. The four bases, proceeding counterclockwise as players must run, are called home plate, first base, second base, and third base. (This terminology will

help you understand American slang. When a young stud says that “he couldn’t get to first base” with his date, you will know to applaud her fortitude and appreciate his frustration.) The batter stands at the home plate, and the pitcher throws (he does not bowl!) from the middle of the infield past the batter (or so he hopes) and to the catcher, crouching behind home plate. The other seven fielders (for a baseball team has nine players) arrange themselves as follows: four infielders (first, second and third basemen, and a shortstop who plays between second and third base because most batters are righthanded and hit more balls this way than between first and second bases); and three outfielders (in left, center and right field—with left and right defined by the batter looking outward from home plate).



As in most games, the object of play is to score more points (called runs in baseball) than the other team in the allotted duration. Baseball, unlike most team sports, does not define duration of play by clock time at all (although the average game lasts about three hours). Each side comes to bat (alternating with

the other side) nine times (called innings, but not otherwise particularly comparable to the fewer and longer items of the same name in cricket). Your team's part of the innings continues until three of your men have been put "out" (to be defined in a moment). The game ends after each side has completed its nine innings (at three outs per inning for a total of twenty-seven outs). The team with more runs wins the game.

The actual procedure is pretty primal. The batter tries to hit safely and run around the bases. The pitcher and his fielders try to put the batter out. A batter may be put out in the following major ways (not including lbw!): if the ball he hits is caught before it touches the ground (called a fly-out); if a ball that hits the ground is snagged by a fielder and thrown to the first baseman before the batter can run to first base; if the pitcher manages to throw three good pitches (called "strikes") past the batter (called a strikeout). "Three strikes and you're out" is therefore a mantra of American culture—something you Brits really need to know if you hope to understand all manner of things American, including Gary Cooper's famous movie line when, playing baseball hero Lou Gehrig, he learns of his imminent death from ALS, now called Lou Gehrig's Disease: "Is this strike three, doc?" In our current climate of conservative backlash, several American states have instituted so-called "strike-three laws" mandating life sentences without possibility of parole for third-time offenders. And how these reprobates must curse the historical contingency that, so long ago and for other purposes, specified three strikes rather than five or six for an out!

If a batter hits safely (usually a ground ball that gets past the infielders and rolls into the outfield, or a fly ball that falls between outfielders), he runs as far as he can—reaching either first base (called a single), second base (a double) or third base (a triple). (The batter stops running when a fielder grabs the ball and throws it to another fielder covering the base just past the batter's last advance—for if the ball reaches a base before the batter does, and the fielder can "tag" the batter with the ball, then the batter is out. Thus, if the batter reaches second base and judges that he cannot get to third base before the fielded ball, he will stay put.) A run does

not score until the batter manages to run around all the bases and reach home plate. Thus, if the batter chooses to stop at second base, he remains there until a subsequent batter hits the ball and permits him to advance. (All manner of rules and customs govern the wisdom and possibility of a baserunner's advancement when a subsequent batter hits the ball—but this we must leave to more learned treatises.)

In the most honored feat of all—another American icon demanding reverential obeisance—a batter may achieve the equivalent of your hitting for six by hitting a fair ball beyond the outfield on the fly and into the spectator's gallery beyond, where a lucky spectator (called a fan), in another time-honored ritual, gets to keep the ball. Such a shot is called a "home run," or a "homer," or a "dinger," or a "round tripper," or a hundred other things (some unprintable and uttered by the pitcher who served up the ball). The batter who hits a home run scores one run for himself, and an additional run for any teammate then occupying another base by virtue of a previous hit—up to a maximum of four runs if the bases are "loaded" (that is, one of your guys on each base), for a so-called "grand slammer". Unlike cricket, where you don't even get to move or brag after hitting for six, any batter who hits a home run then follows the grand ritual of trotting (usually very slowly, for maximal effect) around all the bases in order (sometimes throwing a bird to the pitcher and receiving the finger in return), until he crosses home plate, where all his teammates converge for handshakes and high fives.

I don't want to drown you in details, but I must add (for completion) another way or two for becoming a baserunner without hitting the ball. Three strikes, you're out; but four balls, you're on. If the pitcher throws four errant pitches (outside a small area around home plate and between the batter's belt and knees, called the "strike zone"), then the batter moves to first base with a "walk" or a "base on balls". (Yes, I know, the sphere thrown by the pitcher is a ball. But only errant pitches are called "balls". Accurate pitches are called "strikes". If you found this confusing, you will have to complain to higher powers than this poor author.) In another crucial

motto (with purely practical rather than moral meaning), “a walk is as good as a hit”—for a baserunner on first base is a baserunner on first base no matter how he got there: that is, he will score the same run (if subsequent batters advance him all the way around) whether he got to first base by walking or hitting. A batter also goes to first base if he is hit by an errant pitch—baseball’s only real defense against perpetual mayhem. (We are not civilized enough to call a batter out lbw if he gets in the way of a pitch.)

Well folks, that’s pretty much it. But my library contains eleven large shelves full of baseball books—so there’s a lot of history and subtlety that I’ve left out. You will be on the path to understanding when you grasp the major structural difference between baseball and cricket: in baseball, you must run (and be either safe on a base or out) whenever you hit the ball into fair territory. That is, each safely batted ball must result in either a hit or an out. This custom makes baseball go ever so much faster than cricket (and resolves, for you diehard cricketers, the apparent absurdity that a team could play nine full innings of anything in just a few hours). Baseball seems slow and boring to many hyped-up Americans in the modern age of sound-bite culture. But baseball moves with the wind compared to a game that gives you the option of a null result—no running and no possible run or out—when you hit the ball, thereby mandating a strategy of time-killing by dribbling deflection in certain circumstances. Hey, don’t get me wrong. I love cricket. I also love *Parsifal*.

This entire disquisition finally leads me to the point of all this—an explanation of three key statistics (one for batting, one for fielding, and one for pitching) that measures performance in baseball’s three major activities, and that form the basis for my argument in Part Three:

BATTING AVERAGE: A player’s batting average is simply his ratio of hits to total times at bat (walks don’t count as an official time at bat, for a hitter shouldn’t get credit for a pitcher’s malfeasance, but he hasn’t failed either). Thus, a batting average of 0.300 (considered excellent by the way, and reached by fewer than 10 percent of

players each year) means that, on average, a batter has gotten three hits and made seven outs for each ten times at bat. (In another baseball maxim, we are fond of saying that baseball is the only sport where the best players succeed in fewer than one-third of their attempts.) A batting average of 0.400 indicates four safe hits in every ten times at bat. No one has hit higher than 0.400 in major league baseball since 1941—although seven players reached this level between 1900 and 1930. Part Three uses the key argument of this book to prove, contrary to all voluminous prior discussion of this historical pattern, that (paradoxically perhaps) the disappearance of 0.400 hitting actually measures the general improvement of play in baseball. Read on.

FIELDING AVERAGE: If a batter reaches a base safely because a fielder drops a fly ball that he should have caught, or bobbles a ground ball that he should have snared, or throws a ball errantly to another fielder, then the guilty fielder has committed an "error". The fielding average is simply the percentage of balls handled properly. Since fielders are damned good these days, fielding averages tend to measure near the maximum of 1.000—or all balls handled properly. A fielding average of 0.990—often achieved by the way—really does mean that a fielder has handled 99 of 100 balls accurately.

EARNED RUN AVERAGE (or ERA): This fundamental measure of pitching prowess is simply the average number of "earned" runs scored against a pitcher in a full nine innings. (Thus, an ERA of 2.0 —damned good and rarely achieved—means that a pitcher has given up an average of 2 runs to the other side in each full game.) "Earned" runs are those that can be charged to the pitcher's malfeasance. It would not be fair to blame the pitcher, after all, if a fielder dropped a ball that should have been the third out and the opposing team than went on to score runs—for the pitcher's proper work should have ended the inning with no further runs. (As a general measure of effectiveness in pitching, we prefer the ERA to the simple total of games won, to the ratio of games won to games lost—for the exact same pitching performance will win fewer games

for a lousy team than for a terrific team that backs you up with good hitting and a pile of runs.)

At present, professional baseball maintains two major leagues, each with three divisions. Each team plays a season (April to early October) of 162 games. Two rounds of playoffs follow to determine the champion of each league. The two champions then meet for a best-of-seven set of games (ending when one team scores four victories) called, in our greatest parochialism of all, the World Series. Yes, not *a* World Series, but *The* World Series. And yes again, grown (and reasonably intelligent) people do take this stuff seriously. I have just spent a lovely afternoon at a type-writer telling you why—and I only scratched the surface. Any religion looks nutty to outsiders, but there must be something to it.

PS: Although I am confident that poker has crossed the Atlantic far more efficiently than baseball, I still hesitate to use the American title of this book, *Full House* (a good poker hand expressing both high value and use of all items—that is, the full range of variation). Consequently, I turn instead to my all-time favorite Englishman, Charles Darwin, and adapt his equally appropriate final statement from the *Origin of the Species*—"there is grandeur in this view of life . . ." —as a title for the British edition. I mention this not as an agent for Las Vegas, or as a general shill for American pastimes, but only so that British readers will not be mystified by numerous repetitions of the phrase "full house" in the text of this book. I use this poker metaphor to emphasize my central theme that we can only understand trends properly if we map expansions and contradictions in variation among all items in systems, and cease to focus on the march of mean or extreme values through time.

• *A Modest Proposal* •

IN AN OLD literary theme, from Jesus' parable of the prodigal son to Tennessee Williams's *Cat on a Hot Tin Roof*, our most beloved child is often the most problematic and misunderstood among our offspring. I worry for *Full House*, my adored and wayward boy. I have nurtured this short book for fifteen years through three distinctly different roots (and routes): (1) an insight about the nature of evolutionary trends that popped into my head one day, revised my personal thinking about the history of life, and emerged in technical form as a presidential address for the Paleontological Society in 1988; (2) a statistical eureka that brought me much hope and comfort during a life-threatening illness (see chapter 4); and (3) an explanation that, once conceptualized, struck me as self-evident and necessarily correct, but also diametrically opposed to all traditional accounts, for a major puzzle of American popular culture —the disappearance of 0.400 hitting in baseball.

All three roots arose from a common insight in the form most personally exciting to intellectuals—the eureka or *a-ha!* moment that inverts an old way of seeing and renders both clear and coordinated something that had been muddy, inchoate, or unformulated before. (I speak of a deeply personal experience, not a claim full of hubris about absolutes. Such eurekas only remove scales from one's own eyes and break idiosyncratic impediments. The rest of the world may always have known what you just discovered. But then, some eurekas are more generally novel.) My insight made me view trends in an entirely different way: as changes in variation within complete systems, rather than as "a thing moving either up or down" (hence the subtitle of this book, The Spread of Excellence).

With insight came fear—and for two reasons. First, the theme may seem small and offbeat at first. Why should a different explanation of trends become a subject of general interest? Moreover, and second, the key reformulation (thinking of whole systems expanding or contracting, rather than entities on the move) is fundamentally statistical and must be presented in graphical terms. I did not fear for incomprehensibility. The key idea is as simple as could be (a conceptual inversion, not an arcane mathematical expression), and I knew that I could present the argument entirely in pictorial (not algebraic) terms. But I also knew that I would have to lay out the argument carefully, first making the general point and then developing some simple and preliminary examples before taking on the two main subjects: 0.400 hitting and a resolution of the problem of progress in the history of life.

But would people read the book? Would readers persist through the necessary preliminaries to reach the key reformulations? Would they maintain interest through a graphical development, given our cultural disinclination toward anything that smacks of mathematical style? Yet, I remain convinced that this book presents a novel argument of broad applicability—and that persistent readers may emerge with satisfaction, and in agreement with the father as he pardoned his prodigal son (and justified mercy to his other, persistently obedient child): “it was meet that we should make merry and be glad.”

So let me make a deal with you. As a man who has spent many enlightening, if unenriching, hours playing poker (hence the book’s title), I want to propose a bet. Persist through to the end, and I wager that you will be rewarded (perhaps even with a royal flush to beat my full house). In return, I have made the book short (remarkably so compared with my other effusions), hopefully clear and entertaining (if methodical in building up to the two main examples), and imbued with a promise that two truly puzzling, important, and apparently unrelated phenomena can be explained by the conceptual apparatus here developed.

The rewards of persistence should be twofold. First, I think that my approach of studying variation in complete systems does provide

genuine resolution for two widely discussed issues that can only remain confusing and incoherent when studied in the traditional, persistently Platonic mode of representing full systems by a single essence or exemplar—and then studying how this entity moves through time. I find both resolutions particularly satisfying because they are not so radical that they lie outside easy conceivability. Rather, both solutions make eminent good sense and resolve true paradoxes of the conventional view, once you imbibe the revised perspective based on variation. How can we believe, as the traditional approach requires, that 0.400 hitting has disappeared because batters have gotten worse, when record performances have improved in almost any athletic activity? My approach shows that the disappearance of 0.400 hitting actually records the increasing excellence of play in baseball—and this makes satisfying sense (but cannot be coherently grasped at all under traditional modes of thought about the problem).

Similarly, although I can marshal an impressive array of arguments, both theoretical (the nature of the Darwinian mechanism) and factual (the overwhelming predominance of bacteria among living creatures), for denying that progress characterizes the history of life as a whole, or even represents an orienting force in evolution at all—still, and if only for legitimate parochial reasons, we rightly embrace the idea that humans are uniquely complex, and we properly insist that this fact requires some acknowledgment of a trend. But the explanatory apparatus of *Full House* permits us to retain this commonsensical view about human status, while understanding that progress truly does not pervade or even meaningfully mark the history of life.

Second—and I don't quite know how to say this without sounding more immodest than I truly intend to be—this book does have broader ambitions, for the central argument of *Full House* does make a claim about the nature of reality. I say nothing that has not been stated before by other folks in other ways, but I do try to explicate a broad range of cases not usually gathered together, and I am making my plea by gentle example, rather than by tendentious frontal assault in the empyrean realm of philosophical abstraction (the

usual way to attack *the* nature of reality, and to guarantee limited attention for want of anchoring). I am asking my readers finally and truly to cash out the deepest meaning of the Darwinian revolution and to view natural reality as composed of varying individuals in populations—that is, to understand variation itself as irreducible, as "real" in the sense of "what the world is made of." To do this, we must abandon a habit of thought as old as Plato and recognize the central fallacy in our tendency to depict populations either as average values (usually conceived as "typical" and therefore representing the abstract essence or type of the system) or as extreme examples (singled out for special worthiness, like 0.400 hitting or human complexity). The subtitle of this book—The Spread of Excellence from Plato to Darwin—epitomizes the two approaches, and the importance of owning Darwin's solution.

Full House is a companion volume of sorts to my earlier book *Wonderful Life* (1989). Together, they present an integrated and unconventional view of life's history and meaning—one that forces us to reconceptualize our notion of human status within this history. *Wonderful Life* asserts the unpredictability and contingency of any particular event in evolution—and emphasizes that the origin of *Homo sapiens* must be viewed as such an unrepeatable particular, not an expected consequence. *Full House* presents the general argument for denying that progress defines the history of life or even exists as a general trend at all. Within such a view of life-as-a-whole, humans can occupy no preferred status as a pinnacle or culmination. Life has always been dominated by its bacterial mode.

Both volumes present their basic arguments through particular examples (of an arresting sort), rather than by tendentious generalities—the full range of the Cambrian explosion as revealed in the fauna of the Burgess Shale in *Wonderful Life*; the disappearance of 0.400 hitting in baseball, and the constant bacterial mode of life's bell curve in *Full House*. These cases suggest that we trade the traditional source of human solace in separation for a more interesting view of life in union with other creatures as one contingent element of a much larger history. We must give up a conventional notion of human dominion, but we learn to cherish

particulars, of which we are but one (*Wonderful Life*), and to revel in complete ranges, to which we contribute one precious point (*Full House*)—a good swap, I would argue, of stale (and false) comfort for broader understanding. It is, indeed, a wonderful life within the full house of our planet's history of organic diversity.

So you have my modest proposal. Please read this book. Then let's talk, and have a whale of an argument about all manner of deepest things—and of cabbages, and kings.

Part One

•••

How Shall We Read and Spot a Trend?

• 1 •

Huxley's Chessboard

WE REVEAL OURSELVES in the metaphors we choose for depicting the cosmos in miniature. Shakespeare, unsurprisingly, saw the world as "a stage, and all the men and women merely players." Francis Bacon, in bitter old age, referred to external reality as a bubble. We can make the world really small for various purposes, ranging from religious awe before the even grander realm of God ("but a small parenthesis in eternity" according to Sir Thomas Browne in the mid-seventeenth century), to simple zest for life (as stated so memorably in a conversation between the paragons for such a position, Pistol and Falstaff: "the world's mine oyster, which I with sword will open").

We should therefore not be surprised that Thomas Henry Huxley, the arch rationalist and master of combat, should have chosen a chessboard for his image of natural reality:

> The chess board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us. We know that his play is always fair, just, and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. (From *A Liberal Education*, 1868.)

This image of nature as a tough but fair adversary, beatable by the two great weapons of observation and logic, underlies Huxley's most famous pronouncement that "science is simply common sense at its best; that is, rigidly accurate in observation and merciless to fallacy in logic." (From his great popular work *The Crayfish*, 1880.)

Huxley's metaphor fails—and our task in revealing nature becomes correspondingly harder—because we cannot depict the enterprise of science as Us against Them. The adversary at the other side of the board is some complex combination of nature's genuine intractability and our hidebound social and mental habits. We are, in large part, playing against ourselves. Nature is objective, and nature is knowable, but we can only view her through a glass darkly—and many clouds upon our vision are of our own making: social and cultural biases, psychological preferences, and mental limitations (in universal modes of thought, not just individualized stupidity).

The human contribution to this equation of difficulty becomes ever greater as the subject under investigation comes closer to the heart of our practical and philosophical concerns. We may be able to apply maximal objectivity to taxonomic decisions about species of pogonophorans in the Atlantic Ocean, but we stumble in considering the taxonomy of fossil human species or, even worse, the racial classification of *Homo sapiens*.

Thus, when we tackle the greatest of all evolutionary questions about human existence—how, when, and why did we emerge on the tree of life; and were we meant to arise, or are we only lucky to be here—our prejudices often overwhelm our limited information. Some of these biased descriptions are so venerable, so reflexive, so much a part of our second nature, that we never stop to recognize their status as social decisions with radical alternatives—and we view them instead as given and obvious truths.

My favorite example of unrecognized bias in depicting the history of life resides quite literally in the pictures we paint. The first adequate reconstructions of fossil vertebrates date only from Cuvier's time, in the early nineteenth century. Thus the iconographic tradition of drawing successive scenes to illustrate the pageant of life through time is not even two centuries old. We all know these series of paintings—from a first scene of trilobites in the Cambrian sea, through lots of dinosaurs in the middle, to a last picture of Cro-Magnon ancestors busy decorating a cave in France. We have viewed these sequences on the walls of natural history