

# People are Animals\*

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*Putting it negatively, the myth of eternal return states that a life which disappears once and for all, which does not return, is like a shadow, without weight, dead in advance, and whether it was horrible, beautiful, or sublime, its horror, sublimity, and beauty mean nothing.*

—Milan Kundera, *The Unbearable Lightness of Being*

*She stood to her knees in heavy mud, the red thick water closed below her shoulders. She looked up through the loose fronds of grass at the grey pit of the sky and heard a mutter of thunder. She was quite alone. A long swathe of grass had been beaten across the surface of the water, and around its stems trailed a jelly of frog spawn. ... There she felt the crouching infant, still moving tentatively around its prison, protected from the warm red water by half an inch of flesh. Her stomach stretched and contracted; and the frog swam slowly across the water, with slow, strong spasms of its legs. ... In the jelly spawn were tiny dark dots of life.*

—Doris Lessing, *A Proper Marriage*

*DNA neither knows nor cares. DNA just is.*

—Richard Dawkins, *River Out of Eden*

Is there a point to all this?

Yes.

*There is a reason* why dungflies copulate for 35.5 minutes; why big male reef fish turn into females but little male reef fish don't; why female swallows like males with elongated tails; why more promiscuous primates have bigger testes. The reason is simple. Dungflies, reef fish, swallows, and promiscuous primates who do otherwise leave less DNA. The chemically encoded messages, "copulate for just 28 minutes," "if small, become female," "prefer somewhat shorter plumage," and "if promiscuous, grow a small scrotum" all get passed on to fewer bodies, and so all tend to die out. Messages, on the other hand, that make it easier for animals to grow, mate, and—this is the bottom line—*breed*, all tend to spread. The point of life is the proliferation of life.

## The End

As Darwin put it in *The Origin of Species* in 1859,

As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it

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vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving

—and of reproducing. By a simple process of descent with modification, Darwin explained the geographic distribution of species across space, and the geologic distribution of species over time. Darwin referred to that process as *natural selection*.

But even *if* Darwin's theory fits a few bizarre facts about dungflies and reef fish, monkeys and swallows, what does it say about *us*? Do we cooperate and compete, have sex and raise babies the way we do because our ancestors out-cooperated, out-competed, out-mated, and (this is the bottom line) out-reproduced everybody else?

Yes. From pregnancy complications, to the stress response, to the beauty in symmetry, to the attraction of money, to the historical tendency of the rich to favor firstborn sons, everything we think, feel, and do might be better understood as a means to the spread of our own—or of our ancestors'—genes.

How unlock the mysteries of life? By asking one simple question: What's in it for my own, or for my ancestors', genes? How might, say, making my mother throw up if I'm a fetus, or pulling a baby from a burning building if I'm her big brother, or starting a revolution if I'm a laterborn son help me (or have helped my ancestors) survive, mate, and (this is the bottom line) breed? It seems deceptively easy at first. But by asking this simple question, people have begun to solve an astonishing variety of problems. And solving them is, of course, a good first step toward fixing them.

### **Mothers, Fathers, and Babies**

Take pregnancy. If anything in life approaches perfect loving kindness, it's the bond between a mother and child. Though they inevitably grow apart, they start out almost indistinguishably close. The fetus takes a part of every breath its mother takes, of every bite its mother eats. It carries, and will in turn transmit, its mother's DNA: it's her ticket to genetic immortality.

But, as Bob Trivers was the first to make clear, there's plenty of room for conflict between parents and offspring. Because life is fraught with risks, no parent on earth is meant to reproduce just once. All living things are designed to make more than one copy of their genes. Sibling rivalry is the result: parents are equally related to each of their offspring so, other things being equal, they have an interest in treating them all the same; offspring are more closely related to themselves than to their brothers and sisters so, other things being equal, they have an interest in getting treated better.

The upshot is conflict from the moment of conception. Complications in pregnancy, as David Haig has very cleverly pointed out, can be seen as an effect of this maternal-fetal tug-of-war. Fetus often wants, and sometimes gets, more food than mother is prepared to give. In Haig's words, "Mother and fetus will compete after every meal over the share that each receives." Fetus wants food of higher quality and higher quantity. To these ends, it does two things. First, placental hormones, working on fetus' behalf, oppose the effects of insulin. This improves baby's food *quality* by keeping blood glucose levels higher for longer. Mothers counter by raising insulin production. The result, where the conflict gets to be out of control, is gestational diabetes—a common complication in preg-

nancy. Second, the placenta, again on fetus' behalf, works to raise maternal blood pressure. This improves baby's food *quantity* by giving it access to a more voluminous supply of blood. Mothers counter with vasodilation of their peripheral circulation. But the result, where conflict escalates, is hypertension or, where conflict is out of control, preeclampsia—another common complication. Two key facts fit Haig's tug-of-war hypothesis: mothers with high blood glucose levels and mothers with high blood pressure tend to give birth to bigger babies.

When might parent-offspring conflict get to be most intense? One answer is: When parents are in poor condition. Parents do best, in that case, to scrimp now and splurge later on child care. Another answer is: When mother's babies have different fathers, and when father's babies have different mothers.

First answers first. If would-be mothers in poor condition are evolved to conserve, then it should be harder to make a baby when times are bad. So, says Peter Ellison, it is. Women tend to lose weight, their salivary progesterone levels drop, and they ovulate less often during the preharvest dearth in Zaire's Ituri Forest; after the harvest, the trends are reversed. Across populations—from the Himalayas, to Poland, to Kenya, to Bangladesh, to the peanut-farming Lese of the Ituri—birth rates tend to peak around nine months after a relative feast and to bottom out around nine months after a relative famine. Even after she's given birth, a well-fed mother has an edge: she's likely to ovulate, to conceive, and to give birth again sooner than a lean one.

Second answers second. *Do* babies by different fathers fight harder with mother? Enter, again, David Haig. Hypertension is, it turns out, more common in mothers who have already borne children by someone other than fetus' father. That makes sense, Haig says, since such a fetus is draining maternal resources away from its half sibs (brothers and sisters by the same mother but different fathers) rather than from its full sibs (brothers and sisters by the same mother and the same father). "Genetic imprinting," he suggests, may be the means to that end. Paternal genes, expressed in the fetus, might evolve to raise their demands where mother has had—or is likely to have—babies by other fathers. Interestingly, hypertension is *less* common in women who have lived with fetus' father for longer. As Haig says, sperm may differently imprint in the testes of men in short-term and long-term relationships....

## Kin

So, conflict—even parent-offspring conflict—evolves by natural selection. So does cooperation. When, as a rule, should sharing evolve? Bill Hamilton answered this question with a simple inequality. He said, altruism should be favored by natural selection wherever

$$k > 1/r,$$

where  $k$  is the ratio of benefit to the receiver to cost to the giver, and  $r$  is the proportion of genes they have in common by descent. In short, it makes genetic sense for one body to come to the aid of another to the extent that both bodies carry the same genes.

Who would you pull from a burning building? Gene Burnstein and collaborators asked that question of people in the United States and Japan. Guess what they found? That women were helped a little more often than men; that the young

were helped more often than the old; that closer kin (e.g., “your three-day-old younger sister” or “your forty-five-year-old father”) were helped more often than remoter kin (e.g., “your brother’s ten-year-old daughter” or “your eighteen-year-old cousin”); and that any tendency to help “acquaintances” was slight....

### Husbands, Lovers, and Wives

Affectionate contact is not, of course, confined to kin. Before half sibs and full sibs, nieces and nephews, daughters and sons can be cared for, they have to be conceived. That means mating. For Darwin, mating was such an important source of adaptation that he devoted another book to the subject. He brought it out a dozen years after *The Origin*. And he called it *The Descent of Man and Selection in Relation to Sex*. In it he wrote, “It is certain that amongst almost all animals there is a struggle between the males for the possession of the female. This fact is so notorious that it would be superfluous to give instances. Hence the females have the opportunity of selecting one out of several males.” The difference, he thought, had something to do with the fact that “the female has to spend much organic matter in the formation of her ova, whereas the male expends much force in fierce contests with his rivals, in wandering about in search of the female, in exerting his voice, pouring out odoriferous secretions, &c.”

This point was made clearer, a hundred years later, by Bob Trivers. The key difference between the sexes, he said, is in the “parental investment” they make. Trivers defined PI as “any investment by the parent in an individual offspring that increases the offspring’s chance of surviving (and hence reproductive success) at the cost of the parent’s ability to invest in other offspring.” The effect is a difference in potential reproductive rates: the greater investor (usually, but not always, the female) is an object of competition; the lesser investor (usually, but not always, the male) competes.

When people *are* choosy, what do they want in a mate? One answer is: “Good genes.” Particularly, as Bill Hamilton has pointed out, genes good at building parasite-resistant hosts. Choosy people looking for genes of this sort should look for healthy—colorful, energetic, symmetrical—mates.

Why symmetry? Because exposure to environmental flux of all sorts—like parasites, pollutants, or extreme climates—leaves its mark. Faces, torsos, and limbs all move away from left-right mirror images. Symmetry should be, as a result, “a reliable health certificate.” In a spate of studies, Randy Thornhill, Steve Gangestad, and collaborators have found that New Mexico *men*, but not *women*, with more left-right body symmetry (that is, more equal left and right ankle, elbow, foot, hand, wrist, and ear breadth) have more attractive faces; that German students find symmetrical faces of men *and* women more attractive than asymmetrical faces; that U.S. and Spanish women with more symmetrical breasts have higher age-specific fertility; that in New Mexico, both male *and* female students with more left-right body symmetry say they’ve had sex with more partners; and that in New Mexico couples, *both* men and women with more left-right body symmetry are more prone to infidelity.

As a rule, people haven’t got eyes for equal-sized ankles, elbows, and so on to the nearest .1 or .01 mm. What index might they have evolved to track? For one thing, large body mass. Symmetrical men tend to be bigger men. Arguably, that’s because being massive is condition-dependent: men with “good” genes better resist environmental stress. They grow more regular; and they grow larger.

What—besides symmetry—should make a woman sexy? The “gynoid” look. High waist-to-hip ratios (above .85) in women are associated with high risk of hypertension, diabetes, endometrial cancer, breast cancer, ovarian cancer, and gallbladder disease. So low ratios, Dev Singh says, should appeal. He asked Texas college boys to rank sketches of women with low to high waist-to-hip ratios. Regardless of weight, they liked the lowest (0.7) ratios best and the highest (1.0) ratios least. Hourglass girls were rated healthier, younger, prettier, sexier, more anxious to have children, and better built to bear them.

And what else—besides mass and symmetry—might make a man look healthy? An “android” body. Normal male waist-to-hip ratios run in the .80–.95 range. Low ratios (curvy figures) are more likely in men suffering from hypogonadism, Klinefelter’s syndrome, or advanced cirrhosis—all associated with less testosterone and more estrogen. High ratios (straight up and down) are more likely in men with peptic ulcers, sociopsychological stress, fetal adversities, or retarded growth. Up to a point, Dev Singh concludes, thin hips and washboard abs should look good. He asked Texas college girls to rate line drawings of men with high to low waist-to-hip ratios. They liked the medium-high (0.9, on a scale of 0.7 to 1.0) waist-to-hip ratio most.

To sum up, “sexy” is, among other things, “healthy.” And “healthy” is, among other things, balanced, big, and properly built. In choosing for good health, men’s and women’s tastes overlap. In other respects, though, their tastes are distinct.

Getting “good genes” may worry both females and males; getting “any genes” at all tends to be an exclusively male concern. Why is that? For one thing, a woman’s ability to make babies is closely tied to her age; a man’s is not. For another thing, maternity is guaranteed; paternity is moot. It follows that men, more than women, must monitor age; and men, more than women, should pay attention to chastity.

Doug Kenrick and Richard Keefe found, six times, that men want young women. They looked at personal ads from the *Arizona Solo*; at 1986 marriage statistics from Seattle and Phoenix; at 1923 marriage statistics from Phoenix; at personal ads from Germany, Holland, and India; at marriage statistics from the island of Poro—five hundred kilometers southeast of Manila—for 1913–39; and at personal ads placed by “rich” women and men in the *Washingtonian*. The results were overwhelmingly redundant. Women, regardless of age, want mates their age or older. Young men want women a little older or a little younger; old men want younger women. ....

... Having found “any genes,” a man’s got to guard them. Jealousy may be one evolved means to that end. David Buss and friends found, three times, that men worry more than women about sexual rivals. They asked Michigan students to decide which would bother them more—“imagining your partner forming a deep emotional attachment” or “imagining your partner enjoying passionate sexual intercourse.” Men chose (B); women chose (A). Next, they hooked students up to Ag/AgCl surface electrodes on their first and third fingers to measure electrodermal activity, to photoplethysmographs on their thumbs to tap pulse rate, and to electrodes over their brows to monitor electromyographic activity. Subjects were then “asked to relax.” They were told to imagine either “walking to class”; their serious romantic partner “falling in love and forming an emotional attachment” to someone else; or their serious romantic partner “having sexual intercourse” with someone else. Again, men were more disturbed by sexual, and

women by emotional, infidelity. In their third and last study, Buss *et al.* used another student sample to replicate their first study. This time, they found the sex differences in both sexual and emotional jealousy more marked among those who had been or were really (rather than hypothetically) romantically involved....

... People don't just look for "good genes" when they mate. When people are choosy, what else do they want? The other answer is: A "good provider." Genes are the bottom line—you can't make a baby without them. But the code (DNA) goes nowhere without food. Genes—especially human genes—need nurturing, too. And good nurturers are, among other things, good providers.

Every girl's crazy 'bout a sharp-dressed man. John Marshall Townsend and friends put men in a Rolex watch, designer tie, and white dress shirt with a navy blazer thrown over the shoulder, *or* in a Burger King uniform. Then they asked New York college women how much or little they'd like to have coffee and conversation with such a person; to date them; to have uncommitted sex with them; to have a serious involvement with them; to have a serious, sexual involvement with them; or to marry them. Across the board, women preferred the Rolex to the Burger King man. And, as long as they found her pretty, New York college men preferred well-tailored women as well. Rolex girls, like Rolex boys, were better prospects for coffee, dates, sex, marriage, and romance. As Townsend and Roberts sum up: "Probably everyone would prefer a physically attractive partner who will have a successful career some day." ....

This phenomenon doesn't just work in New York. Natives gave the Ashante Hene (their African Gold Coast king) credit for keeping 3,333 women in his harem. Montezuma II (the Aztec who met Cortés, in Mexico, in 1519) had 4,000. In Peru, Incan emperors kept "houses of virgins," crammed with 1,500 women apiece, in every principal province. In China, emperors kept *t'ang-shih*, "records made with the red brush," after the sexual contacts they made with hundreds of girls on their "correct" calendar days. In India, according to one *Jataka*, the royal seraglio in the fifth century B.C. held a record-holding 16,000. Even His Highness Maharaja Sir Bhupinder Singh, friend to Mussolini and George VI, died with 332 women in his harem ....

In the past, power pretty much paralleled polygyny wherever you went. Aka, Ache, Efe, !Kung, Ifaluk, Yanomamö, Gabbra, Dogon, Mukogodo, Yomut, Kipsigis, Trinidadian, Bakkarwal, Mormon, Lancashire, Locknevi, Soknedal, Ostfriesland, Hungarian, Portuguese, Roman, medieval European, and modern English men with means (meat, land, cash, kin, or rank) have (reportedly) out-reproduced men without. But do they here and now? Does, for instance, money still predict fertility?

.... One thing we ... know: Wilt Chamberlain claims to have had sex with twenty thousand women. "Yes, that's correct, *twenty thousand different ladies*. At my age, that equals out to having sex with 1.2 women a day, every day since I was fifteen years old." In his autobiography, *A View from Above*, he goes on: "I have a feeling a lot of you are saying, 'Come on, Wilt, stop all that bullshit.'" Magic Johnson might not. As he put it in *My Life*, "They say power is an aphrodisiac. Maybe so, but it's not the only one. So is success, and fame, and wealth, and winning." So are forty or fifty twenty-year-old girls waiting in a hotel lobby. Some basketball players—some extremely good, extremely rich basketball players—have had spectacular success with women. Frank Zappa had opportunities as well. Like the "A.G.P.'s" ("*assistant groupie person-ettes*") provided by the "F.G.P." ("*Famous Groupie Person*") on a road tour in Dallas. Certainly, a

few U.S. politicians have been promiscuous, too—though their motives for concealment, in an electoral democracy, are nontrivial.

This question remains: What about the average man? For him, do mating success and reproductive success have nothing to do, anymore, with power, reputation, or cash? Not according to Daniel Pérusse. From October 1988 to April 1989, he dispersed detailed questionnaires to a representative sample of 433 French Canadian men. He found that “social status”—a composite of occupation, income, and education—*failed* to predict number of children. But he also found that social status *did* predict “number of potential conceptions” remarkably well. Men (especially single men) with more income, prestige, and power were having sex more often, and with more women....

### Daughters and Sons, Firstborns and Laterborns

Enough about sex. Back to babies. Back, this time, to parent-offspring *cooperation*. When might parents’ and babies’ interests overlap most? One answer, you’ll remember, is: When babies are full sibs rather than half sibs. Another answer, you’ll also recall, is: When parents are rich enough to splurge on child care. A third answer is: When babies have terrific reproductive prospects.

Enter, again, Bob Trivers—this time with Dan Willard, his mathematician friend. What makes a baby’s reproductive prospects terrific? Among other things, Trivers and Willard say, sex. (There it is again.) A really reproductively successful son may grow up to father hundreds (thousands?) of children by hundreds (thousands?) of women. A really reproductively successful pre-*in vitro* fertilization daughter could never do as well. In other words people, like most other animals, are “polygynous”; and “polygyny” means many females mate with just one male. Given such a situation, Trivers and Willard say, “A male in good condition at the end of the period of parental investment is expected to outreproduce a sister in similar condition, while she is expected to outreproduce him if both are in poor condition.” The effect is that, *other things being equal*, rich parents may be expected to favor sons; poor parents may be expected to favor daughters.

Poor parents first. The Mukogodo are sheep, goat, and cattle herders living in Kenya. Until the 1920s and ’30s they lived in caves, spoke a vanishing language called Yaaku, and ate wild foods and honey. They stand at the bottom of the local, regional hierarchy in wealth, status, and—this is the key issue—reproductive opportunities. Men from adjacent groups—Mumonyot, Digirri, and Ilng’wesi with more cattle, goats, and sheep—have more bridewealth to offer and outcompete Mukogodo men for Mukogodo wives. The result, says Lee Cronk, is that Mukogodo value their sons (whose reproductive prospects are poor) less than their daughters (whose reproductive prospects are better). They take little girls to the Catholic mission dispensary more often; daughters outsurvive sons in the first five years of life; the Mukogodo even report slightly more female than male births.

Rich parents last. In England there are dukes and duchesses, lesser peers and gentry, and a great hoard (as Gregory King uncharitably put it in his *Scheme of the Income & Expence of the Several Families of England Calculated for the Year 1688*) of “labouring people, cottagers and paupers, vagrants, gipsies, thieves, beggars, &c.” Once upon a time, not so long ago, dukes were much richer than gentry, who were in turn much richer than laborers. Accordingly—some evidence suggests—dukes’ sons outreproduced, say, rich yeomen’s sons, who outrepro-

duced, say, cottagers' sons, by a wide margin. The upshots were patriarchy and primogeniture, says Ted Bergstrom.

The patriarchy—or, sons-favored-over-daughters—result follows straightforwardly from Trivers and Willard. Given that strictly monogamously *married* British dukes—like strictly monogamously married Incan, Aztec, Indian, and Chinese emperors—had plenty of opportunities to *mate* polygynously, they had “terrific” reproductive prospects compared with their sisters. Incan, Aztec, Indian, Chinese, and other emperors and lesser nobles kept hoards (dozens, or even hundreds) of guarded, young consorts—and (evidence suggests) often had sexual access to their subordinates' daughters and wives. English dukes, peers, and gentry kept housefuls (dozens, or even hundreds) of unmarried, late-adolescent maids—and (evidence suggests) often had sexual access to their subordinates' daughters and wives.

The primogeniture—or, firstborn-sons-favored-over-laterborn-sons—result follows from the simple law of “increasing returns to scale.” To the extent, for example, that “it takes money to make money,” or that “a divided estate is a conquered estate,” it makes economic sense to pass on an inheritance intact. And, to the extent that rich Englishmen are reproductively successful Englishmen, it makes Darwinian sense as well. Sons of daughters, sons of laterborn sons, and sons of illegitimate children should get small shares of family estates; firstborn sons of firstborn sons should get the lion's share to themselves. In Bergstrom's words, “If expected rates of return to great fortunes are sufficiently larger than expected rates of returns to small fortunes, noblemen will maximize their reproductive value by concentrating inheritance on a single son.”

But when firstborns land on their parents' estates, where do laterborn sons end up? Far away, or dead. In medieval Portugal, for instance, the probability of death in war increased with birth order (firstborn sons' risk was low; fourth-born sons' risk was high); and laterborn sons were more likely to die far from home. As Jim Boone, who reviewed the *Peditura Lusitana*, a fifteenth- to sixteenth-century genealogy of the Portuguese nobility, sums up: “Younger sons who were killed were more likely to be killed much farther away, in India, than their elder brothers, who as youths participated in the nearby Moroccan campaigns, but soon returned to Portugal to take their place in society.” ....

## Friends

Enough about babies. Enough about inheritance, other investments, and the lack thereof. Cooperation, like conflict, is not confined to kin. “Acquaintances” may not get pulled from burning buildings often; but friends help friends all the time. The essential question, for any theory of social life, must be: When? What, other than kinship or sex, makes us scratch each other's backs?

Reciprocity. Darwin was cynical about that possibility. He mused, in *The Descent of Man*, that “as the reasoning powers and foresight ... became improved, each man would soon learn that if he aided his fellow-men, he would commonly receive aid in return.” Darwin thought reciprocity a “low motive” for lending somebody a hand. Bob Trivers was more upbeat. He attributed much we value in human emotion and cognition—including gratitude, sympathy, friendship, trust—to what he called “reciprocal altruism.” That is, to the simple fact that one good turn deserves a return.



What conditions make cooperation likely? Among other things, a big payoff, repeated interactions, and having somebody watch. Put strangers in a room and ask them to start sharing money. You'll find a surprising number of them are willing to make the first move. But, as Elizabeth Hoffman, Kevin McCabe, and Vernon Smith have found out, people are less likely to offer something if they're sure nobody's looking when they offer nothing. As Hoffman *et al.* point out, these results differ "strikingly" from experiments in which subjects are *not* carefully watched by the experimenters. They "demonstrate quite strongly the power of observability in enforcing social norms of equity and (implied) reciprocity."

Cooperation didn't begin with money. Kristen Hawkes has spent the last twenty years on three continents stalking the origins of "collective action." The problem of collective action, in a nutshell, is this: "If one need not give to receive, why give?" It is, in short, *the* problem of human social life. And it has, as Hawkes's work more than anybody's makes clear, been with us for a very long time. Men have, for thousands of years or more, been bringing home big game. But every hunt raised this issue: How should the carcass get split up? The last of the big game hunters, the twentieth-century foragers studied by Hawkes and friends, share the spoils of these kills remarkably fairly. But the killing is done by remarkably few men. In Botswana, for instance, just one man, ≠ Toma, provided 78 percent of the meat for an entire !Kung bushman camp for a month; in Paraguay, among the Ache, good hunters provide up to six times as much meat as poor hunters; and in Tanzania, the range in Hadza meat acquisition rates is from 0 to about 27.25 kg/day. How do good providers get paid back? Not in kind, says Hawkes—there's no evidence of that—but maybe in other currencies. They may get more "social attention": more allies, better child care, more *mates*. In at least one of these groups, the Ache, good hunters are reported to have sex with more (if marginally more) women, and their children are more likely (if marginally more likely) to survive.

There is another, sinister, solution to the collective action problem. Maybe good hunters are being coerced. The critical point is the ratio of effort expended to genes produced. If good hunters work no harder than necessary to feed themselves *and* their dependents—including their legitimate and illegitimate children—then there is no collective action problem. If, on the other hand, the extra food they bring in is feeding *somebody else's* dependents, then good hunters' hands may be forced. Big men (men with more allies, or strong men) may be getting little men (men with fewer allies, or weak men) to do their big game hunting for them. To the extent that good hunters' fitness returns (which appear to be marginal) fail to keep pace with their foraging returns (which appear to be great), the solution to the problem of collective action may be exploitation.

### Hostile Forces

Enough is enough. Having begun (at the beginning) with conception, and got through politics and sex, we end (at the end) with death. Why do we die? Can natural selection account for death as well as birth? Of course.

When poorly provisioned mothers or fathers, indifferent acquaintances, or competitors for symmetrical mates don't get us, we can still get hit by falling rocks or devoured by predators or parasites. Parasites get all of us sooner or later. And a few simple, selective pressures determine how lethal or benign their assault will be. Paul Ewald, by taking a selectionist's-eye-view of the spread of parasite

genes, has revolutionized the study of infectious disease. The severity of a pathogen's attack has to do with how the pathogen is borne. When parasites can replicate only by moving directly from host to host, their genetic fate is completely contingent on their host's mobility. A severely debilitated, bedridden body is unlikely to come in contact with lots of potential new carriers. In this case it makes sense for the pathogen to be less severe: give host a runny nose, but don't lay him low. When, on the other hand, parasites can replicate through "vectors"—when they're carried by insects, say, or contaminated water—they lose less by knocking their hosts out flat. Clean up the water, says Ewald, and put screens on the windows, and the pathogens responsible for cholera and malaria will evolve to be more benign.

Ewald's success with parasites has, in part, prompted Paul Turke to look at how hosts fight back. He's used evolutionary theory to unravel some of the immune system's complexity. Immune systems are involved in perpetual arms races. Their goal is to distinguish "self" from "non-self" while parasites try, in turn, to break into the system by mimicking hosts. To this end the immune system's T cells are screened by the thymus, which spares those adept at distinguishing "self" from "non-self" but induces inept cells to undergo apoptosis, a programmed death. This process, too, can be subverted—by parasites that manage to contaminate the thymus. Turke suggests that hosts have fought back by making T cells long-lived, and by doing the screening very early, even in utero, while still under the protection of mother's immune system. Having done its job, soon after the first year of life, the thymus begins "inexorably and rapidly" to involute—that is, to senesce. To Turke, "Thymic involution is proposed to be an undesirable, unavoidable consequence of strong selection for enhanced early thymic function."

*Even if we get lucky—and manage to survive attacks by parasites, predators, family members, and falling rocks—we will still slowly, but surely, wind down and die. Why? George Williams solved this last, but not least, problem. Senescence—the inevitable, intrinsic decline we all endure with age—is an unfortunate effect of extrinsic mortality rates. Because, again, life is fraught with risks—because predators, parasites, floods, famines, and other "hostile forces" must in the end cause death—any gene that spurs reproduction early in life will have an edge over a gene that spurs reproduction later on. The opposite should hold for genes with bad side effects; they should add up late in life and be culled early. The cumulative effect should be vigor in youth and decline with age. That prediction is borne out, among other things, by two facts. First, in species with high adult death rates due to "hostile forces," senescence is generally quick. As Williams says, "Active adult insects have mortality rates of the order of ten percent per day, and maximum longevity is of the order of a few weeks. Mortality rates of adult man in extremely primitive situations probably never averaged more than ten percent a year, and man's maximum longevity may include as many years as that of the insects includes days." Second, in the risk-taking sex (usually male) senescence is generally faster than in the risk-averse (usually female) sex. Thus, "Throughout the animal kingdom it is a general rule that females are longer-lived than males."*

## **The Beginning**

A lot about life is nasty. There are absent fathers, wicked stepmothers, lopsided bodies, tight belts, disinherited children, and defectors. But they stand out in stark

relief against a lot we take for granted. There are—and there always have been—fathers who stay up carrying crying babies all night, mothers whose hearts swell with love and pride every time they look at their daughters and sons, beautiful people, rewards for hard work, payoffs for risk taking and exchange wherever we look. We dwell on the nasty, in part, because we want to fix it.

Fixing it will necessitate figuring it out. There have been more theories than any of us cares to remember about what people do and who people are. A hundred-odd years ago, Darwin came up with a good one. It's so good it has, in the last seventeen years, shed new light on human anatomy, physiology, emotions, cognition, and interaction. Can we get rid of preeclampsia? Stress? Child neglect? Infertility? Cholera and malaria? Social injustice? We can, if we can figure them out. Knowledge is power. And this theory—Darwin's theory—is the best route to knowledge we've got....