Quammen, David 1985 Natural Acts

IS SEX NECESSARY?

Virgin Birth and Opportunism in the Garden

Birds do it, bees do it, goes the tune. But the songsters, as usual, would mislead us with drastic oversimplifications. The full truth happens to be more eccentrically non-libidinous: Sometimes they *don't* do it, those very creatures, and get the same results anyway. Bees of all species, for instance, are notable to geneticists precisely for their ability to produce offspring while doing *without*. Likewise at least one variety of bird—the Beltsville Small White turkey, a domestic dinner-table model out of Beltsville, Maryland—has achieved scientific renown for a similar feat. What we are talking about here is celibate motherhood, procreation without copulation, a phenomenon that goes by the technical name *parthenogenesis*. Translated from the Greek roots: virgin birth.

And you don't have to be Catholic to believe in this one.

Miraculous as it may seem, parthenogenesis is actually rather common throughout nature, practiced regularly or intermittently by at least some species within almost every group of animals except (for reasons still unknown) dragonflies and mammals. Reproduction by virgin females has been discovered among reptiles, birds, fishes, amphibians, crustaceans, molluscs, ticks, the jellyfish clan, flatworms, roundworms, segmented worms; and among

insects (notwithstanding those unrelentingly sexy dragonflies) it is especially favored. The order Hymenoptera, including all bees and wasps, is uniformly parthenogenetic in the manner by which males are produced: Every male honeybee is born without any genetic contribution from a father. Among the beetles, there are thirty-five different forms of parthenogenetic weevil. The African weaver ant employs parthenogenesis, as do twenty-three species of fruit fly and at least one kind of roach. The gall midge *Miastor* is notorious for the exceptionally bizarre and grisly scenario that allows its fatherless young to see daylight: *Miastor* daughters cannibalize the mother from inside, with ruthless impatience, until her hollowed-out skin splits open like the door of an overcrowded nursery. But the foremost practitioners of virgin birth—their elaborate and versatile proficiency unmatched in the animal kingdom—are undoubtedly the aphids.

Now no sensible reader of even this book can be expected, I realize, to care faintly about aphid biology qua aphid biology. That's just asking too much. But there's a larger rationale for dragging you aphid-ward. The life cycle of these little nebbishy sap-sucking insects, the very same that infest rose bushes and house plants, not only exemplifies *how* parthenogenetic reproduction is done; it also very clearly shows *why*.

First the biographical facts. A typical aphid, which feeds entirely on plant juices tapped off from the vascular system of young leaves, spends winter dormant and protected, as an egg. The egg is attached near a bud site on the new growth of a poplar tree. In March, when the tree sap has begun to rise and the buds have begun to burgeon, an aphid hatchling appears, plugging its sharp snout (like a mosquito's) into the tree's tenderest plumbing. This solitary individual aphid will be, necessarily, a wingless female. If she is lucky, she will become sole founder of a vast aphid population. Having sucked enough poplar sap to reach maturity, she produces—by *live birth* now, and without benefit of a mate—daughters identical to herself. These wingless daughters also plug into the tree's flow of sap, and they also produce further wingless daughters, until sometime in late May, when that particular branch

of that particular tree can support no more thirsty aphids. Suddenly there is a change: The next generation of daughters are born with wings. They fly off in search of a better situation.

One such aviatrix lands on an herbaceous plant—say a young climbing bean in some human's garden—and the pattern repeats. She plugs into the sap ducts on the underside of a new leaf, commences feasting destructively, and delivers by parthenogenesis a great brood of wingless daughters. The daughters beget more daughters, those daughters beget still more, and so on, until the poor bean plant is encrusted with a solid mob of these fat little elbowing greedy sisters. Then again, neatly triggered by the crowded conditions, a generation of daughters are born with wings. Away they fly, looking for prospects, and one of them lights on, say, a sugar beet. (The switch from bean to beet is fine, because our species of typical aphid is not inordinately choosy.) The sugar beet before long is covered, sucked upon mercilessly, victimized by a horde of mothers and nieces and granddaughters. Still not a single male aphid has appeared anywhere in the chain.

The lurching from one plant to another continues; the alternation between wingless and winged daughters continues. But in September, with fresh tender plant growth increasingly hard to find, there is another change.

Flying daughters are born who have a different destiny: They wing back to the poplar tree, where they give birth to a crop of wingless females that are unlike any so far. These latest girls know the meaning of sex! Meanwhile, at long last, the starving survivors back on that final bedraggled sugar beet have brought forth a generation of males. The males have wings. They take to the air in quest of poplar trees and first love. *Et voilà*. The mated females lay eggs that will wait out the winter near bud sites on that poplar tree, and the circle is thus completed. One single aphid hatchling—call her the *fundatrix*—in this way can give rise in the course of a year, from her own ovaries exclusively, to roughly a zillion aphids.

Well and good, you say. A zillion aphids. But what is the point of it?

The point, for aphids as for most other parthenogenetic animals, is (1) exceptionally fast reproduction that allows (2) maximal exploitation of temporary resource abundance and unstable environmental conditions, while (3) facilitating the successful colonization of unfamiliar habitats. In other words the aphid, like the gall midge and the weaver ant and the rest of their fellow parthenogens, is by its evolved character a galloping opportunist.

This is a term of science, not of abuse. Population ecologists make an illuminating distinction between what they label *equilibrium* and *opportunistic* species. According to William Birky and John Gilbert, from a paper in the journal *American Zoologist:* "Equilibrium species, exemplified by many vertebrates, maintain relatively constant population sizes, in part by being adapted to reproduce, at least slowly, in most of the environmental conditions which they meet. Opportunistic species, on the other hand, show extreme population fluctuations; they are adapted to reproduce only in a relatively narrow range of conditions, but make up for this by reproducing extremely rapidly in favorable circumstances. At least in some cases, opportunistic organisms can also be categorized as colonizing organisms." Birky and Gilbert also emphasize that "The potential for rapid reproduction is the essential evolutionary ticket for entry into the opportunistic life style."

And parthenogenesis, in turn, is the greatest time-saving gimmick in the history of animal reproduction. No hours or days are wasted while a female looks for a mate; no minutes lost to the act of mating itself. The female aphid attains sexual maturity and, bang, she becomes automatically pregnant. No waiting, no courtship, no fooling around. She delivers her brood of daughters, they grow to puberty and, zap, another generation immediately. If humans worked as fast, Jane Fonda today would be a great-grandmother. The time saved to parthenogenetic species may seem trivial, but it is not. It adds up dizzyingly: In the same time taken by a sexually reproducing insect to complete three generations for a total of 1,200 offspring, an aphid (assuming the *same* time required for each female to mature, and the *same* number of progeny in each litter), squandering no time on courtship or sex, will progress through six generations for an extended family of 318,000,000.

Even this isn't speedy enough for some restless opportunists. That matricidal gall midge *Miastor,* whose larvae feed on fleeting eruptions of fungus under the bark of trees, has developed a startling way to cut further time from the cycle of procreation. Far from waiting for a mate, *Miastor* does not even wait for maturity. When food is abundant, it is the *larva,* not the adult female fly, who is eaten alive from inside by her own daughters. And as those voracious daughters burst free of the husk that was their mother, each of them already contains further larval daughters taking shape ominously within its own ovaries. While the food lasts, while opportunity endures, no *Miastor* female can live to adulthood without dying of motherhood.

The implicit principle behind all this non-sexual reproduction, all this hurry, is simple: Don't argue with success. Don't tamper with a genetic blueprint that works. Unmated female aphids, and gall midges, pass on their own gene patterns virtually unaltered (except for the occasional mutation) to their daughters. Sexual reproduction, on the other hand, constitutes, by its essence, genetic tampering. The whole purpose of joining sperm with egg is to shuffle the genes of both parents and come up with a new combination that might perhaps be more advantageous. Give the kid something neither Mom nor Pop ever had. Parthenogenetic species, during their hurried phases at least, dispense with this genetic shuffle. They stick stubbornly to the gene pattern that seems to be working. They produce (with certain complicated exceptions) natural clones of themselves.

But what they gain thereby in reproductive rate, in great explosions of population, they give up in flexibility. They minimize their genetic options. They lessen their chances of adapting to unforeseen changes of circumstance.

Which is why more than one biologist has drawn the same conclusion as M. J. D. White: "Parthenogenetic forms seem to be frequently successful in the particular ecological niche which

they occupy, but sooner or later the inherent disadvantages of their genetic system must be expected to lead to a lack of adaptability, followed by eventual extinction, or perhaps in some cases by a return to sexuality."

So it *is* necessary, at least intermittently (once a year, for the aphids, whether they need it or not), this thing called sex. As of course you and I knew it must be. Otherwise surely, by now, we mammals and dragonflies would have come up with something more dignified.