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Homeostasis in Shakespeare

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René Descartes was wrong, and Shakespeare could have told him so. Descartes's hard distinction between the inanimate and the merely living machine-matter, on the one hand, and the mind made of an immaterial essence, on the other, no longer convinces anyone. Since Charles Darwin we have accepted not a hard distinction but a continuous spectrum (indeed, a chain) of complexity and sensitivity connecting the low-order life forms and the higher, and recently it has become apparent that high-order rationality too is just a sophistication of simpler kinds of biological responsiveness. As Antonio Damasio has shown, the apparatus for thinking is built upon the simpler messaging systems common to animals and plants and that, essentially, we think and feel with our bodies and not with disembodied minds (Damasio, 1995). The realization of this embodiment is a key element in the recent 'affective turn' in cultural and literary theory, and it confirms Raymond Williams's strangely oxymoronic claim that in 'structures of feeling' our beliefs and practices – our mental and physical lives – interpenetrate one another (Clough and Halley, 2007; Williams, 1977, pp. 128–35). It is not surprising that with this closing of the gap between humans and all other life (lower forms around us now, and the lower forms from which we evolved), scientists are increasingly finding evidence that the behaviours we call culture, morality, and politics occur in communities of animals (De Waal, 1982; De Waal, 2001; Whiten, Horner and De Waal, 2005). As the editors of this collection note in their introduction, a 'strategic move away from anthropocentric premises' is necessitated by new knowledge of what we have in common with animals, but this does not entail a rejection of all of humanism. This chapter will identify ethical imperatives that, for Shakespeare, seem to be built into human nature by certain facts of life that science is only now fully bringing to light.

In the 1970s the chemist James Lovelock developed an extraordinary hypothesis in which our planet's atmosphere is not the precondition that allowed life to develop on Earth, but is itself the product of life-forms, which made the world comfortable for themselves. This seemed to require that the life-forms collaborated in adjusting their outputs, which idea appeared so far-fetched that early research papers by Lovelock were routinely rejected by academic journals. Lovelock continued working on his hypothesis, and introduced into it the further complexity of the chemical reactions between the atmosphere and rock surfaces as they weathered (a process that bacteria can accelerate) and also the oceans full of algae. The result was a chemical model of a complex interconnected chain of reactions whose ultimate effect was to regulate the conditions on Earth for the benefit of its life-forms. This model he called Gaia. With the entire Earth unified in this way, it seems artificial to distinguish between the parts that are obviously alive (the biota) and the inanimate oceans, rocks and clouds. These inanimate parts are tightly coupled in chemical processes with the biota, and the proper perspective is to treat the entire Earth as a superorganism composed of many kinds of subsidiary organisms. This idea Lovelock first presented in a sequence of papers (the most significant being Lovelock, 1972; Lovelock and Margulis, 1974a, 1974b) and then as a series of books (including Lovelock, 1979, 1988).

Darwin's hypothesis showed that a chain of being unites all of life on Earth in a single, subtly complex, process, and Lovelock's Gaia hypothesis extends this idea up to the planetary scale and down to the mere matter comprising the land, sea and air. In its strongest form, Gaia sees the whole Earth as a living organism, one that might even (in Daniel Dennett's deliberately provocative phrase) have finally grown a nervous system: us (Dennett, 2003b). In its weakest form, which shades off into Earth Systems Science, the Gaia hypothesis treats the Earth's chemical and thermodynamic processes not as life itself but as a collection of tightly coupled feedback loops producing planetary homeostasis, or self-regulation. We see homeostasis all around us, but it can be hard to recognize and explain. For instance, the moon takes exactly as long to turn once on its axis as it does to orbit once around the Earth, which is why it always presents the same face to us, the face it has presented to millions of our ancestors. In the geocentric model of the universe this had been explained by the moon being fixed to a crystal sphere encompassing the Earth and turning with it as the sphere rotated. But once Copernicus and Galileo had worked out the correct locations and motions of the heavenly bodies and Isaac Newton and Johannes

Kepler had derived the forces governing them, the moon turning at just the right rate to keep its face to us looked like a celestial miracle of coincidence. It was almost the twentieth century before George Howard Darwin, Charles Darwin's son, figured out how the laws of gravity make the Earth–moon system self-regulating (Darwin, 1898). If we managed to perturb the moon, giving it an extra spin in order to see around the other side, it would react by turning back to show its familiar face to us, and solely because of gravitational forces.

Earth Systems Science is finding self-regulation in places nobody suspected before, thereby reactivating pre-Enlightenment views on matter, the universe and life. Shakespeare's characters debate self-regulation and find it at work in things we consider to be alive and in things that, until recently, we did not. The Earth shook at Owen Glendŵr's birth, of that the protagonists agree. But why did it shake? Owen Glendŵr says it was out of fear:

GLYNDŴR The front of heaven was full of fiery shapes,
Of burning cressets; and at my birth
The frame and huge foundation of the earth
Shaked like a coward.
(*1 Henry IV*, IV.1.13–16)[1]

Hotspur accepts the shaking but not the cause: 'I say the earth was not of my mind / If you suppose as fearing you it shook' (III.1.20–2). At best, the Earth but belched or farted at Glendŵr's birth:

HOTSPUR Diseased nature oftentimes breaks forth
In strange eruptions; oft the teeming earth
Is with a kind of colic pinched and vexed
By the imprisoning of unruly wind
Within her womb, which for enlargement striving
Shakes the old beldam earth, and topples down
Steeples and moss-grown towers. At your birth
Our grandam earth, having this distemp'rature,
In passion shook.
(*1 Henry IV*, III.1.25–33)

As Edmond Malone pointed out (Shakespeare, 1821, III.1.33, n. 3), the same image of winds trapped in the Earth occurs in Edmund Spenser's *The Faerie Queene* (III.9.15.2–9) and one of Shakespeare's narrative poems: 'As when the wind, imprisoned in the ground, / Struggling

for passage, earth's foundation shakes' (*Venus and Adonis* 1046–7). But in Spenser's poem and *Venus and Adonis* the wind has agency – has a desire for release – and the Earth is merely its prison, a foundation to be shaken. Hotspur, in contrast, sees the Earth as the agent here: the Earth breaks wind to correct itself by relieving the build-up of internal pressure.

These ideas have been an embarrassment to criticism. Shakespeare seems to share his characters' belief in a vital and alive universe rather than a mechanical one. We can tell Shakespeare's view because Hotspur is pricking Glendŵr's pomposity, yet he does not challenge the idea that the Earth responded as a living creature. Hotspur merely substitutes flatulence for fear as the cause of this response. As late as 1765, Samuel Johnson was able to read Hotspur's explanation as 'a very rational and philosophical confutation of superstitious errour' (Shakespeare, 1765, III.1.28, n. 6), meaning that Glendŵr is superstitious and Hotspur's explanation is rational. In the notes to his 1768 edition Edward Capell wrote that as an explanation of earthquakes 'the Poet's physics are certainly right', albeit 'the dress he has put them in ... is suited to the mouth they proceed from' (Capell and Collins, 1779–80, p. 159). I do not suppose Johnson and Capell meant that they accepted Hotspur's image as literally true. I imagine they saw it, much as we would until recently, as a metaphor that comes closer to the truth than Glendŵr's idea of a fully conscious world capable of fearing his nativity.

Until recently, most scientists would have said that, howsoever metaphorical, Hotspur's explanation is unhelpful since there is nothing remotely biological at work in earth tremors. Indeed, the Gaia hypothesis was at first resisted by Earth Systems scientists precisely because it seemed biological. The Gaia hypothesis now incorporates plate tectonics and earthquakes, and hence encompasses the phenomena Hotspur tries to explain (Worsley, Nance and Moody, 1991; Berner, 1991). Earthly exhalation is also where Gaia started, for the atmospheric disequilibrium it set out to explain is the rich concentrations of oxygen and methane that could not co-exist for long were not living creatures replenishing them by respiration and farting/belching. Hotspur was right: the living Earth belches and dead planets do not. It might be objected here that atmospheric methane comes from individual organisms' digestive processes not the whole Earth's. Gaia shows that this distinction between part and whole is false: the living Earth is its collection of parts, as is the organism. The average human has about ten times as many microorganisms – separate creatures with their own DNA and reproduction cycle – living in her digestive tract as she has cells in her

body, and it is these that make her farts and her belches as they break down her food. If we think our effluxes are our own, then we must accept that the Earth's are its own.

Zoologists used to object that the Gaia hypothesis is anti-Darwinian, since planet-wide regulation of the atmosphere seems to imply cooperation that is at odds with natural selection's privileging of the local and the temporary advantage. Gaia, they objected, would require organisms planning ahead for their collective good, which cannot be right. Lovelock's answer invoked a principle that Darwinists only started to think carefully about since the 1960s: the environment to which an organism adapts is not a static background but includes the dynamic behaviour of other organisms, including others of its own species. Moreover, the environment can be altered by an organism. This last point is crucial, since an inheritable trait might be even more advantageous to a creature's descendants than it was to the creature that first developed it, simply because that trait changed the environment against which the adaptation's usefulness is to be measured. This means that determining whether a trait is doing an organism some good (in the evolutionary sense) may be harder than it might at first seem.

In his latest work to address how natural selection might have generated planet-wide homeostasis, Lovelock explicitly puts the case in transgenerational terms regarding mutual interchange between an organism and its environment:

> [T]he first organisms must have used the raw materials of the Earth's crust, oceans, and air to make their cells. They also returned to their environment their wastes and dead bodies. As they grew abundant, this action would have changed the composition of the air, oceans, and crust into an oxygen-free world dominated chemically by methane. This means that soon after its origin, life was adapting not to the geological world of its birth, but to an environment of its own making. There was no purpose in this, but those organisms which made their environment more comfortable for life left a better world for their progeny, and those which worsened their environment spoiled the survival chances of theirs. Natural selection then tended to favor the improvers. (Lovelock, 2004, pp. 3–4)

In other words, competition between, on the one hand, early organisms that left the area around themselves a bit easier for their progeny to live in and, on the other, those that left it a bit harder for their progeny to live in would have favoured the former. The progeny of the

well-behaved had the advantage. This hypothesis does not fall foul of the fallacy of group selection, as Richard Dawkins claimed when he objected that Gaia requires the kind of selflessness that natural selection destroys because 'a mutant plant which saved itself the costs of oxygen manufacture ... would outreproduce its more public-spirited colleagues' (Dawkins, 1982, p. 236). Rather, Gaian natural selection is now taken seriously by mainstream Earth Systems Science (Lenton, 1998).

Of course, Elizabethans had no direct access to any such insights. But in the theologically centred morality of Shakespeare's time the ethic of reciprocity embodied in the Christian Golden Rule – 'do to others as you would have them do to you' (Matthew 7.12) – was obviously a component of interactions within the family, or within a community, or between natives and strangers. Shakespeare repeatedly dramatized how morality emerges from such interactions, both within a generation and, crucially for my argument, across generations of descendants. The Golden Rule seems to govern social interactions within a single generation – the 'others' are those around you now – while natural selection required for Gaia occurs trans-generationally and is concerned with behaviours whose impacts upon evolutionary fitness can only be discerned over time. Shakespeare on occasion addresses such Gaian interactions, by dramatizing selfish behaviour that seems advantageous to the individual considered synchronically but, when considered diachronically, trans-generationally, is revealed as disadvantageous. He was aware that if one's behaviour is inherited by one's children, one faces a kind of Golden Rule played out over time and hence, in crude but I think defensible terms, heredity encourages goodness.

The earliest example of this principle in Shakespeare's work is Lady Anne's curse on Richard Gloucester, in which she imagines him having a child as monstrous as himself:

> LADY ANNE If ever he have child, abortive be it,
> Prodigious, and untimely brought to light,
> Whose ugly and unnatural aspect
> May fright the hopeful mother at the view,
> And that be heir to his unhappiness.
> (*Richard III*, I.2.21–5)

John Jowett thought that Anne's reference to deformity 'glances only indirectly at' Richard's own condition (Shakespeare, 2000, I.2.21, n.) whereas Antony Hammond was sure that Anne is 'describing Richard's own birth' and wondered whether she realizes that she is doing this

(Shakespeare, 1981, I.2.23, n.). Without speculating about the contents of Anne's mind, we can say for sure that 160 lines earlier (about 8 minutes of stage time) Richard called himself 'deformed, unfinished ... half made up' (I.1.20–1), so the audience hears Anne cursing Richard with having a child like himself. King Lear pronounces the same curse on his daughter Gonoril:

LEAR If she must teem,
Create her child of spleen, that it may live
And be a thwart disnatured torment to her.
Let it stamp wrinkles in her brow of youth,
With cadent tears fret channels in her cheeks,
Turn all her mother's pains and benefits
To laughter and contempt, that she may feel –
That she may feel
How sharper than a serpent's tooth it is
To have a thankless child.
(*History of King Lear*, IV.268)

Viewed as a parenting strategy, Gonoril's selfishness defeats itself and the Golden Rule is upheld, not synchronically but diachronically over the generations.

Later Lear realizes a layer of further potential reciprocity: what if he is subject to the same curse he made upon Gonoril? That is to say, might not Gonoril herself be a deserved punishment to him just as he wishes her child to be a deserved punishment to her? The sight of Edgar prompts this thought:

LEAR What, has his daughters brought him to this pass?
(*To Edgar*) Couldst thou save nothing? Didst thou give them all?
FOOL Nay, he reserved a blanket, else we had been all shamed.
LEAR (*to Edgar*)
Now all the plagues that in the pendulous air
Hang fated o'er men's faults fall on thy daughters!
KENT He hath no daughters, sir.
LEAR Death, traitor! Nothing could have subdued nature
To such a lowness but his unkind daughters.
(*To Edgar*) Is it the fashion that discarded fathers
Should have thus little mercy on their flesh?
Judicious punishment: 'twas this flesh begot

> Those pelican daughters.
>
> (*History of King Lear*, 11.56–68)

Lear comes to realize the errors of his ways, and in this regard we may usefully contrast him with the childless king Richard III. Richard has hopes to start his own line of monarchs, but his imagery of generation runs precisely counter to the principle of transgenerational correction I have been outlining. Richard seems to think that by generation he will undo his crimes rather than be called to account for them:

> QEEN ELIZABETH
> Yet thou didst kill my children.
> KING RICHARD
> But in your daughter's womb I bury them,
> Where, in that nest of spicery, they will breed
> Selves of themselves, to your recomfiture.
> (*Richard III*, IV.4.353–6)

The childless Macbeth is much like Richard in brutally hacking his way to the throne only to find that it gives little joy without a child to pass it on to. Indeed, we may suppose that these kings are able to be brutal because they are childless: had they to face the transgenerational consequences of passing on these traits they would learn that selfishness is self-defeating. In their introduction, the editors of this volume sketch Andy Mousley's defence of humanism's interrogations of 'how to live?', and here is a concrete example in Shakespeare's suggestion that the facts of life militate against anti-social behaviour. Perhaps goodness, like freedom, evolves (Dennett, 2003a).

The last plays of Shakespeare's career are especially concerned with relations between the generations. In *The Winter's Tale*, Paulina presents the new-born baby Perdita to Leontes and remarks on its likeness to him:

> PAULINA
> It is yours,
> And might we lay th' old proverb to your charge,
> So like you 'tis the worse. Behold, my lords,
> Although the print be little, the whole matter
> And copy of the father ...
> ...
> And thou good goddess Nature, which hast made it
> So like to him that got it, if thou hast

> The ordering of the mind too, 'mongst all colours
> No yellow in't, lest she suspect, as he does,
> Her children not her husband's.
> (*The Winter's Tale*, II.3.96–108)

Paulina means to show Leontes that he was wrong to suspect that the baby is another's child. But, having asserted that the baby is like its father, Paulina must hope that Perdita is unlike her father in one quality at least: that she is not yellow (the colour of jealousy) lest she think that her children are not her own. This is of course absurd, since the uneven burden of sexual reproduction affords women one certainty: they can at least be sure that the children they give birth to are their own.

Even if heritable, Leontes's jealousy could not be transmitted down the female line, as Paulina appears to recognize as she says this. The Variorum edition of the play cites a number of critics who regard this absurdity as intentional illogic on Paulina's part, meant to show Leontes his own illogic (Shakespeare, 2005, Through Line Numbering (TLN), 1029–30, n.). On the other hand one might argue that this is unintentionally inflammatory and that, having his attention drawn to the certainty of motherhood, Leontes might feel the pain of paternal uncertainty all the more keenly. From the point of view of natural ethics – the kind of Gaian self-regulation that Shakespeare is thinking about – Paulina seems to have put her finger on a problem, since trans-generational relations cannot visit Leontes's disorder upon him in the way that they can revisit Gonoril's ingratitude upon her.

The neo-Darwinian approach to generation distinguishes our ideas from those of the high Enlightenment, and when allied to Lovelock's Gaia hypothesis the effect is that long-standing certainties about the place of humankind in the universe are transformed in ways that philosophers are only beginning to appreciate. According to N. Katherine Hayles, the break that marks the transition to a posthuman condition occurred with the mathematical demonstrations that information could be measured as a quantity distinct from the medium conveying it, and that a machine could exhibit complex homeostasis by using information about itself to regulate its own performance (Hayles, 1999). For Hayles, the humanist subject invented by the Enlightenment depended on an untenable Cartesian distinction between the body and the unembodied mind, and the posthumanist subject is in danger of abandoning the body altogether. The human characteristic we value most is consciousness, which impresses us much more than the (also complex) capacity to catch a fast-moving ball while running or to digest food,

and consciousness she argues – following Antonio Damasio (1995) – is embodied. Thus 'Human mind without human body is not human mind' (Hayles, 1999, p. 246).

In this, however, Hayles's own anthropocentrism distorts the argument, for the humanist subject of the Enlightenment is just as effectively decentred in the new ecological approach that finds in the wider Earth systems (the movements of energy and chemicals in ocean currents, wind and weathering) the homeostatic processes that we once thought were characteristics peculiar to life. Hayles's posthuman condition in which a hard distinction between mechanical and living processes breaks down is also the early modern condition and was familiar to Shakespeare. Indeed, we might even say that Hayles is premature, for there are important ways in which the now-dominant neo-Darwinian approach to life might be an oversimplification regarding the distinction, first made by August Weismann, between the genetic information, akin to recipes, passed down the generations by sex, the so-called germ line, and the bodies built from these recipes, the so-called somatic line. According to Weismann the latter cannot affect the form: an individual's genes are in no way modified by its behaviour. In fact, it seems that the germ line is not quite so isolated from the somatic line as would be suggested by the analogy with information and media.

Work on epigenetics and imprinting, in which the expression of genes may be conditioned by the sex of the parent from which they are inherited (or, more controversially, conditioned by the experiences of the parent), suggests that genetic data are not entirely isolated inside their chromosomes. While this does not amount to a return to Jean-Baptiste de Lamarck's notion of inheritance in which each generation's particularities (the ironsmith's large biceps, the bicycle-courier's powerful calves) are passed on to descendents (the view that Weismann overturned), it suggests interactions that blur the germ/soma distinction. The idea that maternal experiences during gestation affect a foetus has a long tradition and of course emerges in Shylock's story of Laban's trick with his uncle's sheep (*The Merchant of Venice*, I.3.89) and in Edmund's conviction that his fierce personality was imprinted on him by the passionate sex enjoyed by his parents when they made him (*The History of King Lear* 2.10–15).

A particular kind of transgenerational relationship, parent–child incest, is the special focus of the last plays. In *Pericles*, Antiochus has corrupted the normal linear fanning out of family trees by fulfilling in himself the functions of father and husband. This turning in upon

itself of the family is extended so that Antiochus also becomes, as Pericles puts it, 'both a father and a son' (1.170), which peculiar claim we will return to shortly. Marina performs a similar turning inward of family relations when she revives Pericles from his swoon: 'Thou ... begett'st him that did thee beget' (21.183). The widespread taboo against sexual incest in almost all cultures has its biological origins in the genetic binarism of allele pairs in the human chromosome, one half of which came from the mother and one from the father. Many traits, including potential diseases, may be carried by an individual without being expressed because only one of the two alleles codes for that trait; the recessive allele has no effect because of the dominance of its partner that does not code for the trait. Such a recessive trait will be expressed only when both alleles at a given gene-locus code for it, which rarely happens when unrelated individuals mate. But because a brother and sister or a parent and child share 50 per cent of their genes they are quite likely to have the same recessive allele at a given point in their genomes. The children of their incestuous mating are quite likely to inherit the recessive allele from both parents, which is the condition required for the recessive trait to be expressed. Children born of incestuous mating are for this reason much more likely than others to have genetically inherited diseases, which is what the incest taboo exists to prevent.

Rather than being a cultural phenomenon, the incest taboo is a genetically determined behaviour that has been naturally selected: genes which make a parent and child, or a brother and sister, revolted by the thought of sex with one another are likely to do better in the centuries-long evolutionary competition than genes that do not. The latter genes are more likely to find themselves in unhealthy infants who die of genetically inherited disease before adulthood, and hence are less likely to get passed on to the next generation. Natural selection exhibits self-regulation, homeostasis, across the generations, and this offered Shaksespeare a model for his compulsive reworkings of self-healing family relationships – siblings forgiving parents and one another – in his last plays. Genes that do better by raising a taboo against incest need to give individuals a way of determining their consanguinity, and the most obvious way is to make individuals able to recognize their relations in order to avoid having sex with them. When a genealogy is drawn as a family tree, the incest taboo operates to promote the fanning out of lines of descent and to prevent the formation of genetically closed loops of relative-sex which are comparatively sterile because the resulting children have an increased

propensity to die before adulthood. The family tree of a recurrent incestuous relationships would tend towards a denuded bough, its branches withering from disease.

Pericles's sexual desire for the daughter of Antioch is articulated in arboreal terms: 'To taste the fruit of yon celestial tree' (1.64). It is not clear if the daughter is the fruit and her father the celestrial tree, or perhaps she is the tree and the fruit is the sexual enjoyment of her. Her father, however, calls her 'this fair Hesperides, / With golden fruit' (1.70–1) which metaphor casts his daughter as a living contradiction, since she is the object of men's desire and simultaneously the guardian of that object. The riddle Pericles has to solve is written from the mute daughter's point of view ('I am ... ') and, as riddles often are, it is based on an apparent contradiction:

PERICLES
I am no viper, yet I feed
On mother's flesh which did me breed.
I sought a husband, in which labour
I found that kindness in a father.
He's father, son, and husband mild;
I mother, wife, and yet his child.
How this may be and yet in two,
As you will live resolve it you.
Sharp physic is the last.
(*Pericles* 1.107–15)

Even once this is solved as being about incest, the problem of the riddle is not entirely eliminated, since although we can see how her incestuous father would be her father and husband, it remains unclear why he would be her 'son'. Equally mysterious is why she thinks herself not only his wife and child but also his 'mother'. Parallel phrasing occurs in Pericles' soliloquy after Antiochus leaves:

PERICLES
Where now you're both a father and a son
By your uncomely claspings with your child –
Which pleasures fits a husband, not a father –
And she, an eater of her mother's flesh,
By the defiling of her parents' bed,
And both like serpents are, who though they feed
On sweetest flowers, yet they poison breed.
(*Pericles* 1.170–6)

Here Antiochus paradoxically becomes his own son and his daughter a consumer of her mother's flesh.

The point of the paradox emerges if we draw a family tree and consider how incest breaks its conventions by generating loops of inbreeding. In the drawing of pedigrees – the form of family trees Shakespeare would have been familiar with, having had to produce one to apply for a patent of gentility in 1597 – horizontal lines link mates and vertical lines are used to link parents and their offspring, as in Figure 4.1.

In such a schema there is no simple way to represent incest. One possibility is a loop (see Figure 4.2).

This requires an additional directionality that the orthogonal tree structure is not supposed to possess: a slanted line representing sex with an offspring. Alternatively, the individual occupying the position of mate and offspring can be repeated (see Figure 4.3).

A family tree that should fan out is made by incest to fold back on itself, or else it requires contradictory self-division, as in the daughter of Antiochus being both the fruit and the guardian of that fruit. Shakespeare's taste for likening family relations to pendant fruits such

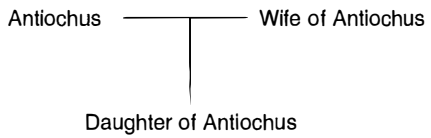

Figure 4.1

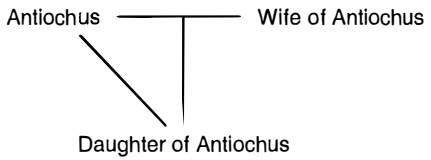

Figure 4.2

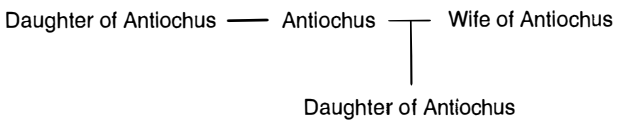

Figure 4.3

as 'dangling apricots' is fully expressed in the celebrated Gardening Scene (III.4) in *Richard II* and in Richard of Gloucester's 'I love the tree from whence thou sprang'st, / Witness the loving kiss I give the fruit' (*Richard Duke of York*, V.7.31–2). Sterility is a common consequence of inbreeding, and Pericles' impresa of a denuded bough green only at the top (the lower branches being dead) might stand for his avoidance of this evil. Antiochus calls Pericles a tree ('so fair a tree / As your fair self', 1.157–8) and Pericles fears that his life may be 'cropped' (1.184). Moreover, Pericles thinks of himself as one of that topmost class in a hierarchical social structure which protects the lower branches:

> PERICLES Our men [will] be vanquished ere they do resist,
> And subjects punished that ne'er thought offence,
> Which care of them, not pity of myself,
> Who am no more but as the tops of trees
> Which fence the roots they grow by and defend them,
> Makes both my body pine and soul to languish,
> And punish that before that he would punish.
> (*Pericles* 2.27–33)

The play's arboreal imagery carries this double sense of diachronic generational fanning out over time and of synchronic social order. As a top branch, Pericles fears that Antiochus, 'To lop that doubt' (that Pericles will broadcast his sin), will cut him off; lopping means cutting off branches; and other uses (such as cutting off heads or limbs, here as in the Gardening Scene in *Richard II*) are figuratively derived from this primary sense.

The avoidance of incest is a purpose of many social practices which are, at root, driven by the genetic imperative to avoid harmful recessive genes meeting at the same locus in the genotype. The means by which organisms avoid incest is the ability to recognize their siblings, offspring and parents, and distinguish them from others with whom they may mate. *Pericles*, like *The Winter's Tale* and *Cymbeline*, is much concerned with this ability to distinguish, and it gives us reason to reconsider the rejection of the categorization that calls these plays the Romances or, still more neutrally yet also being resisted (McMullan, 2007, pp. 65–126), the Late Plays. Thaisa does not even know if she has a daughter, the shipboard delivery being somehow forgotten:

> THAISA That I was shipped at sea
> I well remember, ev'n on my eaning time,

> But whether there delivered, by th' holy gods
> I cannot rightly say.
>
> (*Pericles* 14.4–7)

She does not know it, but the child was a girl so there is no danger of their later meeting and incestuously mating. But Pericles does indeed meet Marina without knowing who she is, and his language upon recognizing her invokes precisely the contradictory self-parenting language of Antiochus and his daughter: 'Thou that begett'st him that did thee beget' (21.183).

The genetic pressure not to commit incest unknowingly is at least part of the motivation unconsciously driving Pericles' and Marina's tense consideration of the means by which identity might be determined, as with her 'Is it no more / To be your daughter than to say my mother's name?' (21.196–7) which might carry the additional sense of 'is mentioning your wife enough to stop you thinking of me sexually?' In the source for Shakespeare's play *The Winter's Tale*, Robert Greene's *Pandosto*, the father Pandosto unwittingly and extensively woos his lost daughter Fawnia and even threatens to rape her if she will not yield to him (Greene, 1588, F4r–G3v). This part of the plot Shakespeare attenuated but did not excise in his version of the story:

> FLORIZEL At your request
> My father will grant precious things as trifles.
> LEONTES Would he do so, I'd beg your precious mistress,
> Which he counts but a trifle.
>
> (*The Winter's Tale*, V.1.220–3)

Incest also lies just beneath the surface of *Cymbeline* in the strong affection of Guiderius and Arviragus for their sister Imogen which only her disguise suppresses: 'Were you a woman, youth, / I should woo hard' (III.6.66–7). Indeed, read as the product of a culture that seemingly understood (as we would not) Gertrude's marriage to her dead husband's brother Claudius to be a kind of incest in *Hamlet*, the avoidance of sibling incest is also the opening problem of *Cymbeline* since the king wished his daughter to marry his new queen's son (I.1.4–6). This unwanted marriage would have been a kind of grafting following the 'lopping' of Cymbeline's rightful male heirs, Guiderius and Arviragus, who at the end are again 'jointed to the old stock' as the prophecy handed down by Jupiter requires (V.3.236, V.4.441–2). It takes passionate complaints and overt threats from the ghosts of his parents and siblings to wring

this rectification of Posthumus' wrongs from the negligent foster-father Jupiter ('Thou orphans' father art', V.3.134), as we should expect since Shakespeare's last plays are so insistently concerned with the correction of transgenerational wrong.

An eco-critic might be expected to stress the cyclical nature of time in these plays, and their use of myths of regeneration to suggest that nature gathers in all with its recurrent return to a starting point. However, it is at least as useful to attend to their dramatizations of self-regulation (homeostasis) achieved by transgenerational correction in which bad behavioural traits inherited by offspring plague the perpetrator. Shakespeare would seem, then, not only to have anticipated the Gaian model of a vitally alive Earth, but also the role of heredity in the evolution of morality as described by Frans de Waal, Daniel Dennett and Richard Joyce among others (Flack and De Waal, 2000; Dennett, 2003a; De Waal, 2004; Joyce, 2006). Of course he anticipated neither of those things; rather, unencumbered by the sharp distinction of matter and mind that dominated Enlightenment science he (rightly, we now know) assumed that the mechanical and the organic lie along a continuous spectrum, or chain of being. Like his contemporaries, Shakespeare had insights that we would call posthumanist.

Notes

1. All quotations of Shakespeare are from Shakespeare (1989).

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