Biohistory

Decline and Fall of the West

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By

Jim Penman

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INTRODUCTION

> "It is better to light one candle than to sit and curse the darkness"
> —Chinese proverb

At the age of 14 a friend gave me a copy of Thucydides' *The Peloponnesian War*.

Thucydides lived in Athens in the late fifth century B.C. He took part in the early stages of the great struggle against Sparta and was exiled, giving him the leisure to write his epic history of the war. In his day, Athens contained more men of genius than any city or nation in the history of the world. Within a period of no more than one hundred years, scarcely more than the lifetime of a man, Athenians took giant strides in such areas as philosophy, architecture, drama, sculpture, science, democracy and of course history. And yet, this great people were shortly to be crushed by Sparta and grow feeble.

Thucydides loved his city though fully aware of its faults, and his account was indescribably moving. Some years later when I read the book again I was unable to even read the section concerning the ill-fated expedition against Sicily. From that moment I began to ask the question "why?" Why did Athens fall from such brilliance to defeat and insignificance? And then came other questions.

Why did the Roman Empire collapse so completely, only a few centuries later? Why did Chinese dynasties so regularly dissolve into anarchy? Why are powerful and wealthy civilizations so often overrun by crude barbarians? So, as a nerdy and introverted teenager, I buried my head in the distant past, searching for answers.

None of the explanations I found made sense—they seemed to focus mainly on institutional changes or the decisions of leaders. But how could imperial policy cause people to have fewer children, or to refuse to join the army, or to abandon the use of money? Government efforts to reverse social trends were extraordinarily futile, as they have proved in our own day. It seemed that *people* were changing, but I did not know how or why. And in the collapse of Rome I found disturbing parallels with current

events in the West. I can remember sitting in my school assembly hall watching the moon landings in July 1969, amidst all the excitement and hope for the future, feeling an ominous sense of foreboding. Could we be travelling down the same route as Rome? And if so, why?

At university I began to read widely over the whole range of human history, looking for patterns of behavior that could be linked to demographic changes and especially to population decline. I also found similar patterns of behavior in cross-cultural anthropology. And then, finally, in physiology and animal behavior. Could the key to history be not economics or politics but *biology*?

All of this was not a good move, career-wise. I had been warned, more than once, that the key to an academic career was to become a specialist in one small field. Now my field had become so broad that it not only covered all of history but anthropology and psychology and economics. And now I wasn't even prepared to stick to human beings as a species. Any academic position was out of the question.

But this was not the only problem. I had come to the conclusion that attitudes and behavior were very strongly influenced by early life experience, and that these effects were somehow physiological. To take this further I needed a biological research program, and this would require a great deal of money. So I set about turning my part time student lawn-mowing business into what became Australia's largest franchise network, with 3,300 Franchisees in four countries. In odd days snatched from the business I continued with my own research.

Finally, in early 2007, I approached Dr (now Professor) Tony Paolini in the Psychology Department at LaTrobe University, Melbourne, who had expertise in areas relevant to the theory. I offered funding to do some very specific experiments, mostly involving mild food restriction in rats. The results confirmed certain aspects of the theory and also helped to develop it further. These findings, together with recent breakthroughs in the new field of epigenetics, provided a biological explanation for the historical and demographic patterns observed.

A note on evidence

This book fully explains biohistory and is complete in itself, but only contains some of the supporting evidence, especially in relation to the biological sciences. Readers interested in a fuller picture, including how

biohistory applies to different historical periods and full academic references, are referred to my book *Biohistory*.[1] Details are available at www.biohistory.org.

CHAPTER ONE

OF SCIENCE AND TEMPERAMENT

Most people say that it is the intellect which makes a great scientist. They are wrong: it is character.
—Albert Einstein

In 2007 the collapse of the U.S. housing market plunged the financial world into crisis. Trillions of dollars had been invested in mortgages with poor security, which was laid bare by the fall in house prices. Many mortgage lenders went bankrupt. Major institutions such as Northern Rock, Bear Stearns and Fannie Mae were taken over or nationalized to prevent a wholesale meltdown of the financial system. Western economies were plunged into recession.

Governments used all the levers that economic theory said would solve the problem. Deposits were guaranteed, economies primed with massive government spending, and interest rates reduced to near zero. Then they sat back and waited for the recovery that must surely come.

Seven years later, for much of the developed world, it has yet to arrive. Growth rates are anaemic or even negative. Unemployment through much of Europe is at catastrophic levels, especially among the young. Government debt has spiralled out of control. Greece is effectively bankrupt and other countries are on the edge, torn between unsupportable debt and the fear that further austerity might cause an outright collapse.

America is doing better, but even here there are ominous signs which long predated the crash. Real wages more than tripled between 1875 and 1975 but have been largely stagnant ever since.[2] Birth rates have plunged below replacement levels in all Western nations, with the consequent prospect of declining, aging populations. People are losing faith in government. Fewer of them vote, and membership of political parties is at a fraction of its former levels. The gap between rich and poor has grown dramatically, with a hollowing out of middle income earners.

It is not only economic and political indicators that are deteriorating. Obesity levels are rising and drug use is epidemic among the young. Sperm counts and testosterone are falling, and there are ominous signs of a rise in infectious disease.

Parallels can be seen in the history of ancient Rome. In that time there was also a growing gap between rich and poor, with sturdy peasant farmers giving way to vast slave estates owned by wealthy aristocrats. Faith in government collapsed, leading to the end of republican rule. The birth rate plummeted. The economy went into a long-term decline, from which it never recovered. It is worth noting that these trends occurred in ancient Rome—as in the modern West—after society had begun to cast aside its traditional religious and moral systems, especially those relating to control of sexual behavior.

Such parallels are only useful to us, of course, if we know *why* the Roman Empire collapsed, because only then can we know whether the same forces are in action today. Biohistory provides a clear answer to this question, and also makes clear that the same thing is happening today and for exactly the same reasons. It also explains why the decline was briefly checked in the late third century AD, and why the Eastern Empire did *not* collapse in the fifth century

But there is more to biohistory than just the decline of civilizations. It also explains how and why civilizations arise. It casts light on why the Industrial Revolution took off first in northern Europe, and why Japan, uniquely among non-Western nations, was able to swiftly adopt and use the new industrial technologies. It also helps to explain why most of Africa, despite almost a century of aid, remains desperately poor and backward. It takes particular issue with the idea that this might be about race, or genetic differences.

Biohistory proposes that the key to all of this—from the decline of Rome to the Industrial Revolution and the current financial crisis—is temperament. Some countries are wealthier than others because the people in them are harder working, more innovative, more willing to sacrifice present consumption for future benefit, less inclined to corruption as a government official, and so forth.

This is not a moral judgment. Wealthier peoples may also be less generous to friends and family, less indulgent with their children, less spontaneous, and greedier. Nor does it mean that all people in the society fit some

national stereotype. For example, some people in society A may be harder working than many in society B. But if the average citizen of society A is harder working than the average for society B, this may have profound implications for wealth and other characteristics of each.

This is not a unique insight. In his superb book *A Farewell to Alms*, economic historian Greg Clark shows how the temperament of English people changed since the Middle Ages, such as in their working longer hours and being more prepared to sacrifice present consumption for future benefit. One example is the increased price of land relative to rental return, which meant people were prepared to accept a lesser return on their investment. He maintains that this change fully explains the economic explosion of the late eighteenth and early nineteenth centuries.[3] He does not provide an explanation for the change, apart from a suggestion that it may be genetic, but his evidence that there *was* such a change is powerful and convincing.

Temperament can also be used to explain political and institutional changes. One of the key distinctions biohistory makes is between "personal" and "impersonal" loyalties. The strength of political leaders ultimately depends on who supports them and to what extent. When loyalties are at their most personal, people will only support a leader they know well. At one extreme this means that political power cannot extend reliably beyond the local village, since a local leader can always prevail over one from the neighboring village. At most a leader can drive away the enemy and take their women and land, but as a section of the community takes over the vacant territory it becomes politically independent.

As loyalties become more impersonal they can extend to a local baron or tribal leader, who might be seen occasionally but is less well known. The next step is a king, rarely seen but still an identifiable individual. The most impersonal loyalties of all are to the laws and institutions of a republic.

As an illustration, consider the career of Richard Neville, Earl of Warwick in fifteenth-century England. Originally a supporter of King Henry VI, he became the chief supporter of the house of York and helped to put King Edward IV on the throne. Finding his influence curbed by the queen's family, he switched sides again and helped restore Henry VI, before being defeated and killed in a final battle which brought Edward once more to power. His followers seem to have simply gone along with all these changes, fighting for and against whichever claimant their lord told them

to. Their loyalty was personal and local to their lord, whom they knew, rather than to their king.

To use a modern analogy, if the governor of California tried to depose Barack Obama and make Mitt Romney President he would gain very little support. Even soldiers and policemen who had voted for Romney would most likely ignore or arrest him, because their loyalty to the Constitution would outweigh their support for the man. In fact, in the present political climate such an attempt would be so futile as to be considered evidence of insanity. Six hundred years ago, this was politics as usual.

The same principle of changing temperament can explain the decline of Rome. As will be shown in chapter twelve, there was a clear change in the character of the Roman people during the late Republic and early Empire. As loyalties became more personal the Republic gave way to the Empire, and as they became more personal still the Empire itself collapsed. At the same time, an advanced market economy (which is an impersonal way of exchanging goods) changed to one based on subsistence farming and tributes to local leaders.

More recent events can also be explained in these terms. Saddam Hussein, as ruler of Iraq, was a brutal tyrant. When his health minister merely advised that he step down temporarily to help peace negotiations with Iran, the minister was sacked, arrested and killed, and pieces of his dismembered body delivered to his wife the following day. Saddam's campaigns against rebels and regime opponents involved poison gas, torture, assassination and (according to Human Rights Watch) the estimated loss of 250,000 lives.[4] Many more died in his abortive invasion of Iran. Many, if not most, Iraqis lived in terror of the regime.

In March 2003, the United States and its allies invaded Iraq, aiming to depose Saddam Hussein and thus bring peace and democracy. More than ten years later, with a trillion dollars spent and countless lives lost, they withdrew without having achieved either goal. The new government proved hardly more democratic than the old one, and was menaced by a brutal new foe in the Islamic State.

The answer to the puzzle of why Iraq did not become a peaceful democracy can be found in a community study done fifty years ago in Egypt, another Arab country with a very similar culture. The people of Egypt tended only to accept authority that was harsh and intimidating,

indicating a fundamentally different temperament to that of people in the democratic nations of the West.

> The people thought of authority as necessarily involving an assertion of power and dominance, and could not respect those who did not display these attributes. Writing of the eighteenth century it was observed that, "if the peasants were administered by a compassionate multazin they despised him and his agents, delayed payment of taxes, called him by feminine names … They still consider both Government and Government officials as agencies of imposition and control, and hence to be feared."[5]

When people only obey rulers who are brutal and terrifying, it is brutal and terrifying men who make the most effective rulers. More lenient men are ignored or brushed aside. The United States and its allies thought that removing Saddam would turn Iraq into a peaceful democracy. They were wrong, because Saddam's rule merely reflected the kind of leadership the majority of Iraqis were temperamentally inclined to accept.

The same can be said of nations affected by the Arab Spring in recent years—either ongoing chaos (Libya and Syria) or renewed autocracy (Egypt). Similar patterns occurred after the Russian Revolution of 1917 or the French Revolution of 1789. Ending one autocracy quickly gave rise to another one.

The idea that economic and political systems reflect the prevailing temperament is not conventional wisdom, but it is not original either. Nor is it original that such attitudes might have a physiological basis. Recent research has indicated that attitudes towards matters such as politics, religion, and capital punishment are deeply rooted in biology and that the 'reasons' given for them are largely rationalizations.[6]

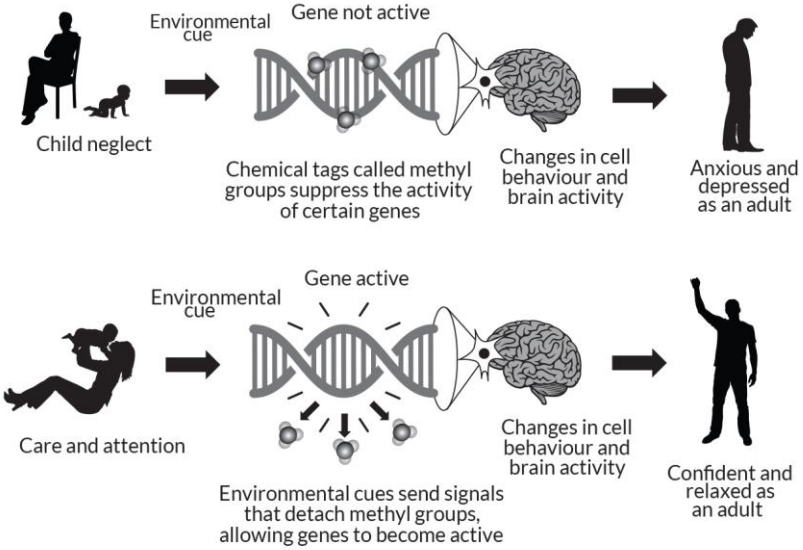
Biohistory is the study of history, as well as of economics, psychology and anthropology, united by a common strand of evidence in biology. Different temperaments are traced back to the influence of early life, in particular the extent to which parents control or punish their children at different ages. For example, chapter five suggests that the classic Arab temperament stems from extreme indulgence of infants combined with harsh control of older children.

Biohistory takes issue with the idea that differences between peoples can be explained by genetics, such as the idea that Europeans and East Asians are more intelligent.[7] Even if such a difference could be demonstrated it would be far less important than differences in temperament determined

by the environment. Overall, differences between and changes within societies cannot be explained in terms of inheritance. Genetically speaking, human beings are very similar to each other. It is often said that there is more genetic diversity in chimpanzees from a few hectares of rainforest than in the entire human race.[8] Genetic differences cannot explain, and are not needed to explain, differences in wealth, creativity, political institutions or much else that matters.

But at another level, people are profoundly different. This is at the level of epigenetics, the new science which looks at the way in which genes are switched on or off by the environment. Thus, two people with similar genes but different early environments can be remarkably different in attitudes and behavior, as different genes become more or less active. These epigenetic differences can make people more or less hard working, rigidly dogmatic or open to change, peaceful or violent, timid or forceful, honest or corrupt, accepting or rejecting of brutal authority, and much more. An example is given in Fig. 1.1 below.

Fig. 1.1. Example of an Epigenetic effect. A simplified overview of epigenetics, development and behavior. Early experience has a major influence on attitudes and behavior.



What is more, these differences tend to pass from generation to generation, partly by direct inheritance but more by the way children are treated in early life. And they have profound effects on the political and economic make-up of societies. If people are epigenetically primed to accept only the most brutal forms of authority, then governments will tend to be brutal or unstable. When people are epigenetically primed to be innovative, to act with integrity and inclined to work hard, national wealth grows. When men are epigenetically primed to be aggressive and proud, wars break out. Thus it is that biology, more than anything else, determines the nature of society.

Culture, the ideas and practices that define how people should think and behave, has a profound impact, but not in the way most people think. First, culture largely reflects the underlying character of the people. When people are aggressive by nature the culture is warlike. War is glorified, and men are praised and valued for courage and pride. But culture also has an impact on the underlying biology. Practices such as patriarchy, control of sexual behavior, religious rituals and different ways of rearing children all have epigenetic effects. These in turn cause changes to character, which in turn influence culture in an ongoing cycle. All of the questions given above have answers couched in physiological terms.

To fully understand these answers, which constitute the underlying mechanisms that drive human culture, we must turn to animals. All mammals, including human beings, appear to have an inbuilt mechanism allowing them to rapidly adjust to changes in food availability. This means they can change behavior within a generation or two to suit environments with chronically limited food or occasional famines. By a strange quirk of biology, these same behaviors and attitudes are exactly what civilization requires. The story of human cultural evolution can be seen as a process by which societies which managed to trigger this mechanism most effectively, without any idea of what they were doing or why, overcame those which did it less well.

This biological foundation of biohistory provides one major benefit lacking in other social theories—it is *testable*.

The scientific method has been an outstanding success in helping people to understand the world, and to develop technologies and drugs that improve and lengthen our lives. And at the core of the scientific method are two quite simple ideas. The first is that, all things being equal, we prefer the simplest theory to explain the available facts. And second is that a

scientific theory should generate non-obvious hypotheses that can be tested, and on that basis the theory is confirmed, modified or refuted.

As an example, Einstein's theory of Relativity predicted that light should be affected by gravity and bent by a specified amount when passing near a massive object such as the sun. This had never been observed, and no competing theory made any such prediction. The trouble is that the sun is so bright that it drowned out light from distant stars. The only way to test the theory was by a total solar eclipse, observed in the right place and with exactly the right weather. Scientists spent many years traipsing around the world in pursuit of just such an event, and eventually made observations. The sun's gravity bent the light of distant stars, and by exactly the amount Einstein predicted. Thus was Relativity confirmed.

For the social sciences this approach has proved difficult, to put it mildly. To take just one example, historians have many different explanations for the Second World War, including the personality of Adolf Hitler, resentment at the Versailles treaty, aspects of German national character, and more. But the only way to absolutely prove any theory would be to run the twentieth century again without one such element (for example, take out Hitler), which is clearly impossible. By contrast, chapter nine explains war in terms of maternal anxiety, and suggests a form of blood testing that could confirm or refute such an idea.

Testing the theory

This is not a "common sense" view, but common sense is not a necessary criterion for a theory to be valid. For example, neither Relativity nor Quantum mechanics are especially plausible theories. Light can be "bent" by gravity? A particle can be in two places at once?

Biohistory is science in that it explains a wide range of data, and it is testable both inside and outside the laboratory. The research program cited earlier is an example of just such testing, as a result of which the theory has been confirmed in some areas and modified in others. It may be noted that biohistory is the only theory of history ever to have resulted in ten papers (and counting) in high ranked biomedical journals. Each chapter contains an example of proposed tests. It is my hope that researchers will take up the challenge and put biohistory to the test.

In the next chapter we will look at aspects of family and personal behavior that are associated with large political units and advanced economies. By

finding those same characteristics in certain animal populations, and working out their physiological basis, we will begin to understand the biological foundation of the temperament that underpins civilization.

CHAPTER TWO

FOOD RESTRICTION

Every time you cuddle with your children, you're likely to be driving down your testosterone.
—Helen Fisher

This book is concerned with the mechanisms by which biology underpins human culture and civilization. In order to understand those mechanisms, we start by contrasting the behavior of civilized peoples with those in smaller scale or tribal societies. Some of these differences are obvious. Civilized peoples are more likely to form large states and obey distant leaders they have never met. They are more likely to trade goods and use money rather than operate a subsistence economy. And compared with hunter-gatherers or primitive horticulturalists they are generally better at the routine work of farm, factory and office.

But looking more closely it becomes clear that there are also surprising differences in family and personal behaviors. Compared to small-scale societies, civilized peoples are far more likely to systematically control and direct their children's behavior, to form nuclear monogamous families, and to delay the start of sexual activity. [9]

An example of one such a community is the Japanese village Niiike, studied in the 1950s. Niiike was part of a nation state which controlled tens of millions of people and had an advanced industrial economy. Control of children was systematic and consistent from earliest childhood.[10]

> Training of children beyond the toddler stage is a conscious goal of Niiike parents and grandparents. They have certain well-defined goals to which they direct their efforts … The child must learn early and well, however, to obey and conform to certain inflexible rules. Obedience is easier, perhaps, in that these are rules for a way of life followed by everyone he knows, not rules made especially for children. Many express the pattern of hierarchy. Speech is one example.

Their family and sexual patterns were those which cross-cultural analysis shows to be typical of civilized societies. All marriages were monogamous, and brothers who married moved out of the family household to form new nuclear families, though one son (usually the eldest) continued to live with and look after his parents. There was little premarital sex, at least for women, and the stigma of sexual misbehavior made it much harder for a girl to marry. Marriages were arranged at a relatively late age, and marital sex did not seem to be very rewarding for women.[11]

> The sex act itself usually is a brief, businesslike affair with a minimum of foreplay. The husband, after waiting in the quilts at night for the rest of the household to settle into slumber, grasps his wife and satisfies himself as quietly and inconspicuously as possible.[12]

This same pattern has been the norm in all Western societies until quite recently, and in a slightly different form throughout India, China and the Middle East.

Consider by contrast the Yanomamo, an indigenous people of the Amazon rain forest. They had no political organization beyond the village, and even villages were commonly split by vicious feuds. Much of their food was gained by horticulture but the work only took a few hours a day, and the men tended to spend more time hunting.

Though this was a fiercely warlike people their attitude to children was lenient in the extreme.

> Yanomamo are indulgent with children … Children are punished infrequently. However, a severe beating is sometimes given suddenly by an angry parent. Spanking, or other formalized punishments, are not used.[13]

Boys in particular enjoyed a relatively control-free childhood that could stretch into their late teenage years, compared to girls who started work much earlier by assisting their mothers with chores.

Marriages were polygynous or even polyandrous in form, with successful men typically having multiple wives. The less successful might have none, or a number of men might share a single woman. Sexual activity started early and married women frequently had affairs, despite the brutal punishments inflicted by jealous husbands. The abduction of women was a common source of feuds. A bigger contrast to the Japanese pattern could hardly be imagined.

Note that the key distinction in terms of childrearing is in *control*, rather than punishment. Although Yanomamo children were allowed more latitude and were indulged, Japanese parents were actually *less* likely than the Yanomamo to inflict painful punishments on their children. Parents in civilized societies may or may not punish their children, but they almost always control them, giving them fewer liberties and more prescribed rules of behavior.

Given the different levels of development between these two societies, it is important to understand the nature of these behavioral differences, what they mean, and where they come from.

Our first clue to understanding this puzzle comes from the study of animal societies. Curiously enough, all of the mating and childrearing behaviors that distinguish complex and small-scale human cultures have direct equivalents in monkeys and apes. As an example, some populations start to have sex and breed immediately after puberty, while others delay for many years. Some form troops where males have access to several females, while others defend territories as monogamous pairs. There is no exact equivalent to the control exercised by human parents, but some populations favor their young with far more time and attention.

The one common point about animals which exhibit behavioral traits that in humans are associated with civilization (late breeding, monogamous nuclear families, time spent with young) is that they tend to live in places where food is in short supply. This does not mean they are starving, but that they routinely experience mild hunger. Mild hunger is defined as equivalent to what humans experience during weight loss programs; there is no health-threatening malnutrition, just a diet comprising less food than one would like to have.

Chronic mild hunger gives rise to a series of hormonal, behavioral and epigenetic changes which adapt a species' behavior to a food-limited environment, enabling efficient use of available resources. By a strange quirk of biology, these same physiological changes have produced behavioral traits in human beings which, taken collectively, have adapted people to the requirements of civilization. They make people harder working, better at trade, more able to co-operate in large groups. For this to work, people do not even need to be hungry. Human societies, by a process of trial and error, have developed cultural practices which mimic the physiological effects of hunger. Thus we can act and think like hungry primates, even though we are not actually short of food.

It is variation in the level of this "hunger" mechanism which explains many differences between societies, especially economic success and type of political organization. Changes in the level of this mechanism also explain why civilizations rise and fall, as later chapters will explore.

Primate social behavior—gibbons and baboons

To get an idea of where these different behavioral effects come from and what their use in the wild might be, let us begin by looking at two species that live in very different environments: Asian gibbons and African baboons.[14] Each species is subject to very different patterns of food availability, as well as having to deal with differing sets of environmental hazards, such as predators. In consequence, they display markedly different social behaviors.

Gibbons are found in the tropical forests of Southeast Asia. Living high in the forest canopy, they are physically adapted for brachiating—swinging spectacularly from tree to tree with their immensely long arms. There are many different species of gibbon, grouped within the family Hylobatidae, but their behavior is quite consistent across species.

One of the remarkable things about gibbons is that they are some of the fussiest eaters on earth. They will only eat the leaves or fruits of certain trees, and then only at certain stages of ripeness. The peculiar consequence of this is that, even though they live in one of the world's lushest habitats, calories are hard to find. Their favored foods are widely and thinly scattered through the forest, so gibbons have to spend a lot of time foraging and traveling.

Despite this scarcity, gibbons rarely starve. There are food plants available in every season, and there is little variation from year to year. There is always something for them to feed on, no matter how difficult it may be to find. For most gibbon populations, being hungry is a fairly constant state. For Malaysian gibbons, food is so hard to find that individuals can only just maintain themselves, even with an exclusive territory. Squabbling within groups over food is common and is the main way in which young are expelled from a group. Because they live high in the trees, gibbons are rarely taken by predators. This means that gibbon populations are limited only by the availability of food.

The habitat of African baboons is very different from that of gibbons. They are ground-dwelling. Although they can be found in hilly country

and woodland, the species we are interested in live on the open savannah. Unlike gibbons, baboons are omnivores and not overly picky about what they eat. Predators, mainly leopards and lions, are a constant hazard. Together, these two factors mean that there is usually plentiful food.

But the baboon environment is also much less stable. In times of drought, food can run low or even disappear, resulting in severe hunger and even starvation.[15] Thus, baboon populations are limited not by chronic food shortage but by predators and occasional starvation.

As you would expect, the social behavior patterns of baboons and gibbons are markedly different, in keeping with the habitats in which they live.

Gibbons, living in a state of constant low-level food restriction, are relatively unsociable. They tend to form very small social units, typically a mated male and female. Each pair lives within a territory which they defend from other gibbons. Adult males drive away other males, and females other females, including their own offspring once they pass the age of puberty. In biological terms, this makes very good sense. When food is limited, only an exclusive territory makes it possible to successfully rear young.

Baboon behavior is at the other extreme. Baboons spend far more time socializing within their group, which is much larger than that of gibbons. Their troops normally consist of multiple males and females (though in areas of more limited food there may only be one male with several females). The dominant male tends to monopolize females and sire most of the young, with other males having access only when he is distracted.[16]

Since predators are plentiful and hard to avoid in the open, baboons are active in defense. Against lions they raise the alarm and attempt to hide in trees (if available), but a leopard will be fiercely mobbed if cornered in a tree or a hole.[17] It is not uncommon for leopards to be killed in such attacks. This behavior also makes biological sense. With food plentiful there is no need for an exclusive territory, and a large troop can give warning against lions and help mob leopards.

By contrast, gibbons are timid in the face of threats, and will swing away through the treetops at the slightest danger.[18] This again makes biological sense—there is no point risking your life by attacking a predator that is unlikely to catch you.

Gibbons and baboons differ in their reproductive strategies. Gibbons are slow breeders. They are long-lived, discriminating in their choice of mates, and breed very slowly—much more slowly, in fact, than they physically could, as pairing and reproduction are delayed until well after sexual maturity. [19] Puberty is also later than for other species. This makes perfect sense in an environment with scarce food, where too many offspring could either put disastrous pressure on resources or result in very high infant mortality (which is a waste of the energy resources put into breeding). The dangers of overly fast breeding are illustrated by the fact that gibbons are prone to miscarriage and premature birth, all factors likely to result from poor nutrition.[20]

Baboons breed early and fast and are less choosy about mates. With food plentiful most of the time, the young are more likely to survive. Fast breeding also compensates for deaths caused by predation.

There are other differences. Baboons tend to wean early and provide little care after that age. Gibbons keep their young close until puberty. Baboons find food easily and spend much of their time socializing and resting. Gibbons spend far more time foraging for food, necessary when food is limited but also due to a matter of temperament (as confirmed by the rat experiments described below). In human terms they are primed to work hard, which is a key characteristic of people in civilized societies.

Changing food-restricted behavior

There is still another crucial difference between gibbon-type and baboon-type social behavior—adaptability. Gibbon behavior is adapted to a food-short environment but is not a direct response to it. For instance, even when gibbons have plentiful food (such as in captivity), they remain slow breeders and are socially intolerant. These behaviors are evidently rooted in their genes.[21]

Baboons are far more flexible. The environments they live in are more varied and include savannah, woodland and desert. Baboons in more stable environments with low predation (such as woodland) behave more like gibbons, forming smaller groups and breeding later and less frequently. It seems they can change their behavior as a direct response to food shortage.

It does not take much thought to realize that such flexibility provides a huge advantage. Animals entering an environment where food is short can quickly adapt to the new conditions, chasing away competitors and

slowing breeding to maximize the survival of their young. But if enough are killed that food becomes more plentiful they can immediately breed faster to make up the numbers.

Such flexibility is common in primates. Vervet monkeys are like baboons in forming multi-male troops when food is plentiful, and one-male troops when it is more limited. Mentawaian langurs are bolder and form larger troops in regrowth areas with plentiful food, and monogamous nuclear families in untouched forests with more limited food.

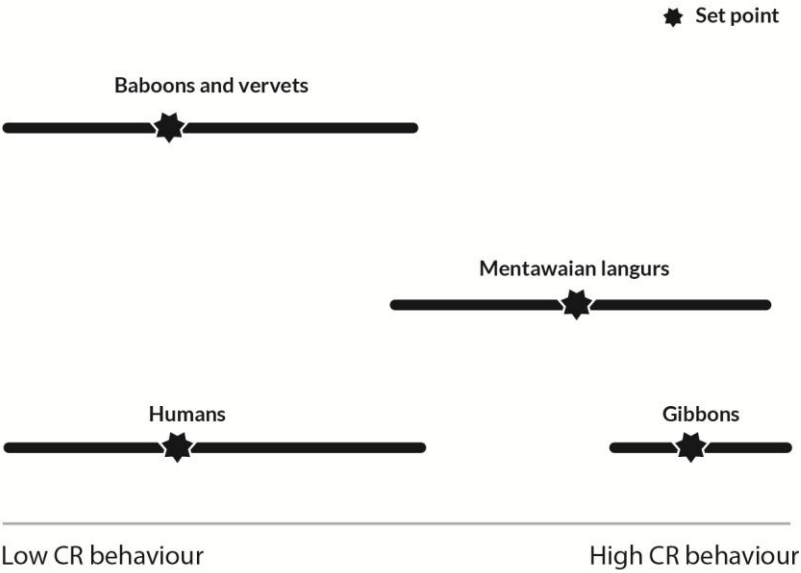
It is important to note that this flexibility has limits. Baboons and vervets have not been observed to form monogamous nuclear families, and Mentawaian langurs vary from monogamous pairs to one-male troops, but do not form multi-male troops. Each species has a range of variation that goes only so far. Baboons and vervets on the "food-plentiful" end, and langurs on the "food-short" end. Gibbons are also on the food-short end, but with little variation. Each has a "set point" which determines the behavior that is most natural to the species and presumably set by genes, but with a limited ability to change in each direction.

Where do humans fit in? Judging by the behavior of hunter-gatherers, who are closest to our ancestral way of life, we belong on the "food plentiful" end. Hunter-gatherers normally live in multi-family groups which travel and hunt together. For example, the Mbuti pygmies, who live in the Congo region of Africa, form social units consisting of at least six to seven families, the minimum required for the Mbuti practice of hunting with nets. The maximum size of such groups is determined partly by the needs of hunting, with too many people seen as a disadvantage.[22] In short, this is nothing like the gibbon or langur pattern where couples or polygynous males defend an exclusive patch of land. In this respect human hunter-gatherers act more like baboons and vervets than gibbons. Humans are far more likely to form pair bonds than most primate species, but do so *within* the multi-male band. In other words, such pairs do not defend exclusive territories as gibbons do. A suggested "set point" and range of variation for each species is given in Fig. 2.1 below.

In overall behavior, the lifestyle of modern hunter-gatherers suggests that ancestral humans were more like group-living baboons than territorial gibbons, apart from unusually strong pair bonds. This mechanism, which adapts behavior and attitudes to the level of food availability, is the key idea of biohistory and the main driving force behind civilization. Given that civilized societies are more successful at producing food it might be

expected that they would show more food-plentiful behavior. But, as we have seen, civilized peoples show all the characteristics of *food-restricted* behavior.

Fig. 2.1. Proposed set points and range of variation in food-restricted behavior in various primates including humans.



If this theory is to hold water we must answer one question—how does the mechanism work? How could mild hunger result in all these far-reaching changes in behavior? And given that, why do civilized peoples show similar characteristics when not especially short of food?

Food restriction—hormones, epigenetics and behavior

To study the food shortage mechanism in monkeys or humans would be expensive and very difficult. Fortunately, rats and mice demonstrate exactly the same responses. For example, a recent study supplemented the diet of mice with a little extra sugar—about equivalent to a human drinking three cans of soft drink a day. This is, in effect, a condition of super-abundant food. These mice not only had a higher death rate than the control mice, but 26% fewer males were able to establish territories.[23]

Thus, in 2007 I approached Dr Tony Paolini with a proposal to study the effects of mild food restriction on the physiology and behavior of laboratory rats. This is a subject surprisingly little studied in rats, much less than starvation. As indicated earlier, starvation or malnourishment has very different effects from mild restriction. It is hugely stressful and dangerous to health, compromising the immune system, causing extreme fatigue and weakness, irritability, anaemia, apathy, reduced coordination, and loss of concentration, as well as acute liver damage.

In our studies, rats were given food-restricted diets 25% below the level that would be taken by free feeding (in some experiments rising to a 50% reduction for short periods). The diet contained adequate levels of protein, vitamins and minerals, and was in no way detrimental to health. It was similar to that of properly conducted weight-loss programs for humans.

What follows is a short overview of the experiments, the results and comparable evidence. A fuller description of the experimental procedures and data can be found in *Biohistory*.[24]

Testosterone reduction

Previous studies of acute (i.e. short-term as opposed to chronic long-term) food restriction have found that it reduces the male sex hormone testosterone in a variety of mammals, including humans. Our studies confirm this, showing reduced testosterone in rats with mild chronic food restriction.

In other words, a *reduced diet brings down the level of testosterone*. The social implications of this are significant. High testosterone is associated with stronger sex drive, aggression and dominance. Men with high testosterone are less likely to be married or in a committed relationship, and when they are married they spend less time with their wives. If we think back to our gibbon and baboon groups, the variation of testosterone as a result of restricted or abundant food fits with the more active sexuality and weakened pair bonds of baboons (whose environment contains plentiful food most of the time), and the stronger mating bonds of gibbons.

The greater aggression of baboons in both their social behavior and their response to predators is also consistent with higher testosterone. The link between testosterone and aggression is strong, and has been found in both animals and humans. The most violent prison inmates (including women) have higher levels of testosterone. Men with high testosterone are more

likely to be delinquents, to use drugs or abuse alcohol. And while they tend to be more effective as combat soldiers, they are more likely to go AWOL. Testosterone is also linked to sensation-seeking and high-risk behavior. High-testosterone people are also more gregarious, more likely to need the company of others, and are less happy alone. This too is consistent with the larger social groups formed by baboons.

Given the assertiveness of high-testosterone individuals and the tendency for the dominant males in animal groups to have high testosterone, it seems odd that status in human society (or at least modern Western societies) seems to be inversely related to testosterone. In our culture, high status tends to be linked to a person's profession, and occupationally successful people usually have *lower* testosterone. Testosterone levels tend to be highest in the unemployed, next in blue collar workers, lower in sales, and lowest in professional occupations.

Other occupations, not necessarily high status, have distinctly low testosterone. The lowest levels of all are found in farmers, and country people in general seem to be lower in testosterone than city dwellers. Ministers of religion also tend to have low testosterone.[25]

Reduced testosterone is also associated with more attentive maternal care. This fits with the closer care of infants observed in human societies in food-restricted environments.

Stress hormones

Hunger is a stressful experience so we might expect a restricted diet to increase stress. In fact, mild food restriction has a surprising effect on stress hormones. It raises the level of corticosterone, but reduces or has no effect on adrenocorticotropic hormone. This is an interesting result, because corticosterone (or its equivalent cortisol in humans) acts to minimize the harmful effects of stress. It also helps recovery from stress by winding down the stress response. People who have post-traumatic stress disorder show lower levels of cortisol than those who have recovered from their traumatic experience without developing PTSD.

High cortisol can also eliminate the aggressive effect of testosterone; adolescent males with high cortisol and high testosterone are no more aggressive than those with low testosterone. In fact, high corticosterone/cortisol actually lowers testosterone. This is another fact