

# INTRODUCTION

In the early decades of the twentieth century, hormones excited scientists as much as genes do today. They were regarded as 'signal' molecules, the body's premier chemical messengers. It seemed so persuasive, the idea that the study of the chemical secretions of a dozen or so glands could reveal how we are, and why we behave in the way we do.

Hormones have now become part of our day-to-day language, a way of accounting for our own and other people's behaviour. The butt of jokes, they feature seriously in law. A bodybuilder who killed his children by setting fire to his home can claim that he was driven by 'steroid rages'.<sup>1</sup> The very word 'hormone' implies reckless action. Scientists coined the term in 1905, from a Greek verb meaning 'to stir up, urge on', and the noun for 'impulse'. Lawyers can plead for clemency for female clients on grounds of premenstrual hormone imbalance.<sup>2</sup> Meanwhile, menopausal women are encouraged to seek 'hormone replacement therapy'.

The belief that hormones have the power to control what we feel and how we behave runs deep in scientific and popular culture alike. But the chemical underpinnings of human

## RAGING HORMONES

behaviour continue to elude the scientists. The data are contradictory, the evidence is contested, the picture grows ever more complex. Yet the fundamental research programme continues, its conceptual framework apparently unassailable.

Something strange is happening here. Both the controversy surrounding hormones and behaviour, and the persistence with which a link is sought, suggest the impact of powerful cultural imperatives. The fact that hormones are most often seen as 'something women have' is, as we shall see, most revealing of all.

### **The Rage for Hormones**

Hormones have become inexorably linked with particular 'effects'. Scientists took out glands and then put them back, or injected pulverised extracts and watched what happened. They marked the waxing and waning of a cockerel's comb, and charted the swelling and shrinking of a rat's testicles. Such physical changes became markers of a hormone's presence, and enabled researchers to isolate hormones from messy glandular extracts. Scientists who specialised in the study of hormones – endocrinologists – came to believe that judicious injections of purified glandular extracts would hold the key to everything from bird migration to human aggression. An animal's behaviour came to be seen as just another hormonal effect.

In laboratory rats, researchers expected to find one hormone for male libido, another for female. When, in 1935, Oscar Riddle and his colleagues isolated the hormone prolactin in nesting ring doves, their discovery was heralded as the key to 'maternal instinct'.<sup>3</sup> The lack of the right hormonal complement was later linked to both postnatal depression and a failure to 'bond' with the child, leading to 'bad' mothering.

Yet the endocrinologists' desire to answer the question 'which hormone brings about what behaviour?' was continually frustrated.<sup>4</sup> The discrepancies became increasingly glaring as researchers moved from fish, reptiles and birds to mammals. Behavioural scientists had to resign themselves to the fact that hormones were not living up to expectations.

But the quest continues. Today, the focus of research is on

## INTRODUCTION

the action of hormones on the brain, 'the organ of behaviour'. New specialisms have sprung up, linking hormones, brain and behaviour. Yet while many specialists in these fields are convinced that they will ultimately be able to explain human behaviour, they emphasise the enormity of the project and the complexity of the 'causal nexus'.

In their preface to a leading textbook published in 1990, *Hormones: From Molecules to Disease*, Etienne-Emile Baulieu and Paul Kelly acknowledge the multifarious ways in which the social and physical environment can alter a person's hormones: 'Hormones respond to changes in brain activity, and to physiological, environmental and social influences, so endocrinology can be truly called a *humanistic science*.'<sup>5</sup> The authors might audaciously be proposing that the social sciences should be seen as branches of endocrinology – that life can be reduced to the waxing and waning of hormones. Yet they are quick to qualify any claim to hold the key to human understanding: 'But since unexpected levels of complexity of hormonal systems are continually being unearthed, it seems apparent that – in spite of our optimism – any notion of "state-of-the-art" is ephemeral.'

### **Monkey Business**

An international meeting of primatologists, held in Brazil in July 1988, reflected the tensions evident in contemporary hormonal research.<sup>6</sup> A symposium was devoted to the new field of 'socioendocrinology', defined as the study of the links between the social environment, hormones and behaviour. The organisers of the symposium, Fred Berkovitch and Toni Ziegler of the University of Wisconsin, see hormones as providing the body 'with a method to respond to the external environment'. Hormones become a tool of the organism, not its taskmaster, and allow 'the body to be flexible under changing social environments'. They emphasise 'interactions' and speak of flexibility and change.

Another American primatologist at the conference, Carol Worthman, spelt out the apparently radical agenda of the new discipline. Endocrinology erred in its early days 'for the sake

## RAGING HORMONES

of expediency'. It was far easier to ignore an animal's social context and think of hormones as having a fixed effect. This empirical tradition fostered a view of hormones as causes of behaviour, Worthman argued, rather than as participants in a web of regulation.

The study of monkeys and apes, humanity's closest relatives, has threatened the classical view. The complexity of the social worlds they inhabit militates against simple chemical triggers for particular actions.<sup>7</sup> Even monkeys are not slaves to their hormones, argues Barry Keverne, director of the sub-department of animal behaviour at the University of Cambridge. The sexual behaviour of the monkeys he studies is not tied to the neuroendocrine events that determine ovulation or sperm production. Indeed, most sexual encounters take place outside the female's fertile period, or during pregnancy. The monkeys' complex social interactions are the key to understanding sex and reproduction; in our primate relatives, behaviour has become 'emancipated' from sex hormones, Keverne argues. And if monkeys and apes are not controlled by their hormones, primatologists conclude, there seems little reason to suppose that human beings are.

One recent study suggests that hormones do not 'cause' sexual behaviour even in birds. Through a series of rather grisly experiments involving surgically deafening and silencing female doves, Mei-Fang Cheng of Rutgers University in New Jersey has demonstrated that the females normally 'talk' to their ovaries. It is the female's own cooing, not the courtship of the male, that stimulates the hormonal changes needed to trigger the release of a mature egg. The presence of the male is important only in that he stimulates the female to make this noise. Cheng says hers is the first example of an animal making sounds that alter its own internal state.<sup>8</sup>

### **Identity Crisis**

Hormones themselves are becoming harder to defend as classical chemical messengers – as a special class of chemicals with independent effects. To classify as a hormone in the traditional sense, a molecule must travel through the bloodstream

## INTRODUCTION

to some distant target cells. These target cells define themselves by their possession of the appropriate receptor – a distinctive molecular hook or docking site that can recognise and physically latch on to a particular hormone. The fusion of hormone and receptor in turn sets off a chemical chain reaction, a cascade of biochemical events, which may activate certain genes and eventually lead to changes in what particular cells do. For instance, hair sprouts out of dormant follicles, breast cells multiply, fat deposits expand, all in response to oestrogens surging from a girl's ovaries at puberty.

So a hormone's effects can radically alter, depending on which cells are displaying how many of the appropriate receptors. For instance, it does not matter how much hormone someone has in their blood if receptors are thin on the ground, and all sorts of factors can influence receptor status. Moreover, hormones can become inactivated if they attach to binding proteins in the blood. These chemicals are also destroyed at different rates in different circumstances. Hormones circulating in the blood are heir to a variety of metabolic onslaughts, especially from the liver, fat tissue and kidneys; most hormone molecules are destroyed even before they encounter any receptor-laden cells. The target site itself often chemically alters the hormone, and so enhances or lessens its effects. Finally, complex feedback loops involving many different chemical interactions influence how much hormone the glandular cells continue to produce.

Hormones that circulate in the bloodstream can also be released locally, to influence the cells that produce them (an autocrine effect) or to act on neighbouring cells, a phenomenon known as a paracrine effect (from the Greek *para*, 'to the side'). One hormone, somatostatin, was originally discovered in the hypothalamus in the brain, but it also acts as a local hormone in the pancreas. Insulin and steroids, once thought to be made only by the pancreas and sex organs respectively, are also produced in the brain. Many other messenger chemicals, such as various growth factors, are manufactured by cells that are not organised into glands, yet they may act much as the traditional hormones do.

## RAGING HORMONES

Classically, hormones were thought of as robust chemical signals that surged through the bloodstream towards their target tissues. Nerves spoke a completely different language, and a private one at that. Their chemical messengers merely linked one nerve cell to another, passing on an electrical signal like so much telegraph wire. Now this distinction is becoming increasingly blurred. For instance, molecules which everyone thought were classic hormones have since turned up in nerve cells in the brain. Chemical communication by nerve and hormone represents a continuum, not rigidly alternative systems. And evidence is growing that the endocrine system, the immune system and nervous system all interact at many levels. Complex neural and feedback networks integrate a vast array of information garnered from inside and outside the body. Recent research on birds, for instance, suggests that their brain cells possess the enzymes necessary to either activate or inactivate sex hormones, and that their social environment influences which enzymes are active.<sup>9</sup>

So some researchers have shifted away from the 'hormone-behaviour' determinism so popular in the 1960s and 1970s. Today, a recent textbook concludes, a wise endocrinologist avoids dogmatic predictions about precisely what any one hormone will do, for what hormones do depends on the circumstances.<sup>10</sup> The most you can safely say, Baulieu and Kelly conclude, is that hormones 'are modulators of the potential of each specific cell'. A cell's potential, they say, is defined by what kind of cell it is, but also 'circumstantially, by age, metabolism, activity, etc.'. Elsewhere, Baulieu reminds fellow scientists that hormones do not simply determine behaviour: 'one should not forget', he says, 'that the state of neural activity is also related to action, emotion and thinking'. Yet as one scientist in the field wrote recently:

the trend in behavioural neuroendocrinology is to focus on a single sex, a single behaviour, or a single hormone. This is evident in studies in which the investigator may spend years determining the reproductive cycle in the male (or female) while ignoring the potential contribution of the partner.<sup>11</sup>

## INTRODUCTION

Why this tension in current scientific practice? Why do some scientists make bold claims about the links between hormones and behaviour, while others are more cautious? Why are some reluctant, and others eager, to extrapolate from experiments on laboratory animals to humans? It is tempting to conclude that one sort of science is 'good', the other 'bad', but it is difficult to substantiate any such claim.<sup>12</sup> What we need to understand are the ways in which larger social and cultural concerns impinge on what can appear to be simply scientific, technical debates about the relationship between human experience and inner chemistry.

### **Whose Hormones?**

One of the central themes that emerges from a look at the science of hormones is the distinctly different ways in which hormonal accounts have been applied to women and men. Hormones are frequently proffered as explanations of women's everyday experience – so much so that a tendency to 'hormonal imbalance' has become a defining characteristic of women today. The situation is subtly different for men. 'Male' hormones are typically regarded as the source of male violence and sexual aggressiveness, yet this is rarely viewed as a problem. Male hormones are treated as pathological only among men regarded as 'deviant' – homosexuals, criminals and mental patients, for instance – and even then there is a marked reluctance to manipulate a man's hormonal makeup. The typical contemporary male, supposedly invigorated by testosterone, is culturally accommodated; the normal woman, by contrast, may be encouraged to seek medical assistance to control her raging hormones. Women are expected to manage and to take responsibility for their own hormonal states, but they are also expected to tolerate, and to manage the best they can, the hormonally induced behaviour of men.

Men have long regarded themselves as potentially under threat from the hormonally deranged woman. Now the hormones themselves seem to be at large in the environment, endangering the very foundation of masculinity. There have long been rumours that the breakdown products of oral

## RAGING HORMONES

contraceptives in women's urine somehow find their way back into the drinking water, to pose a threat to male virility. Recently, oestrogens in the environment have again made the headlines, after two scientists reported that various synthetic chemicals, including some pesticides and detergents, can mimic oestrogens.<sup>13</sup> Such pollutants, the researchers suggested, might have contributed to the demonstrable rise in the rate of testicular cancer, and to the apparent fall in sperm counts, over the past fifty years. The scientists hypothesise that the damage is done by the exposure of vulnerable male fetuses to an overdose of oestrogen in their mothers' womb.

There is much debate about whether the levels of synthetic oestrogens in the environment are great enough to have any significant effect on a fetus's exposure levels: pregnant women produce high levels of the hormone in any case. But on the face of it, this potentially alarming story seems free of gender bias – it is taken for granted that men will be at risk from contamination by the essence of woman, the 'female' sex hormone. 'Men who complain they are at the mercy of female hormones may be closer to the truth than they realise,' writes Jenny Hope, medical correspondent of the *Daily Mail*.<sup>14</sup> 'For the latest scientific thinking argues that while we are all living in a world that is a "virtual sea of oestrogens", Hope claims, 'it is men that are suffering. The very concept of manhood appears to be under threat.' According to Hope, oestrogens are 'subtly feminising' men in the womb and during childhood.

Yet oestrogens are naturally present in both men and women, where the hormones perform a variety of functions related to cell growth and development. At the same time, women too may be at risk from excess oestrogen from the environment – as suggested by the growing evidence that oestrogens in contraceptive pills and hormone replacement therapy increase the risk that women will develop breast cancer or cancers of the reproductive tract. The newspaper reports all used the vocabulary of 'a sea of oestrogen' and the threat to masculinity; no reporter looked beyond the sex stereotype to explore what might really be going on.



## INTRODUCTION

### The 'Discovery' of Sex

The origins of this urge to see women as the hormonal sex stretch back several centuries. The contemporary concern to discover biological differences between the sexes – and thus to ground socially constructed gender roles in something seemingly fixed, immutable, given – is by no means unique to our time. The current drive to compare and contrast bits of male and female physiology is only the latest development in a scientific tradition that dates from the Enlightenment. The fascination with difference seems to have begun then. Before the eighteenth century, medical opinion saw women as intrinsically like men: they were inferior, certainly, but they were regarded as variations on a single theme. There was only one sex, really. Women differed in their sexual anatomy, but only as an obverse of men: the vagina was an interior penis, the womb was a scrotum, the ovaries were testicles. In this pre-Enlightenment view, as the historian Thomas Laqueur recounts in his book *Making Sex*, the body represented, but did not determine, social gender.<sup>15</sup>

With the Enlightenment a new philosophy came to predominate – the notion that there are two sexes, with woman the opposite of man, with inexorably different organs, functions and feelings. The point here is not that pre-Enlightenment folk got their anatomy wrong – every generation finds fault with its ancestors' received wisdom. The crucial point is that since the Enlightenment the body has been seen as determining gender differences.

The history of sexual science over the past three centuries shows just how powerful is the cultural imperative to scour the body for signs of difference, which can then be used to justify gender-based social distinctions. Drawing on Victorian debates, Cynthia Eagle Russett finds examples to substantiate her claim that science and medicine of the day helped to maintain a social order structured around gender, class and race.<sup>16</sup> She argues that the spur for much research lay in the perceived threat of newly assertive women seeking to enrol in universities or enter the professions. Woman's sexual difference, and concomitant unsuitability for a life outside the domestic

## RAGING HORMONES

sphere, was variously attributed to the size of her skull, an affinity with lower organisms, arrested development, maternal destiny and criminal tendencies.

Londa Schiebinger argues that our current understanding of biological difference between men and women developed from Victorian notions of 'complementarity' – the belief that there are 'natural' and clear-cut mental and physical differences between the sexes which translate directly into separate roles within society.<sup>17</sup> Anatomical differences were used to bolster the argument that 'moral and intellectual qualities were innate and enduring as the bones of the body'. She, too, points to the cultural 'discovery' of gender during the Enlightenment. Early anatomical illustrations of male and female skeletons were indifferent to dissimilarities between the sexes, and often failed to give the sex of an illustrated figure. But by the mid eighteenth century, the artists often deliberately exaggerated the differences, inflating the size of the female's pelvis and shrinking her head and ribcage to correspond to emerging ideas of masculine and feminine.

Theories come and go as new findings conflict with the received view, but gender remains central to science and medicine. Indeed, as Ludmilla Jordanova has cogently argued, gender, as one of the strongest determinants of personal identity and social relations, profoundly influences scientific conceptions of 'natural knowledge' – the construction of ideas about what is there to be studied, categorised, discovered.<sup>18</sup> In a striking way, recent debates about phenomena as diverse as homosexuality, premenstrual syndrome and sex therapy variously echo these historical themes.

### **Body Politics**

Hormonal accounts play another, related, role in contemporary culture. Hormones have an enduring appeal for late-twentieth-century Euro-Americans, because they epitomise the central concern with 'control'. Current conceptualisations of aggression, stress and eating disorders – all linked to hormones in various ways – reveal a shared concern with some

## INTRODUCTION

inner process in danger of exploding out of control. Individuals are expected to 'manage' appropriately these bodily impulses and desires, and seek medical help when there is a problem with 'self-control'.

Contemporary preoccupation with internal body management reflects the contradictory pressures and tensions of modern social and economic life. Cultural anxieties about the regulation of desire in consumption-driven capitalist societies become displaced on to the body. As the anthropologist Mary Douglas has argued, the body becomes a system of 'natural symbols' that reproduce social categories and concerns.<sup>19</sup> Thus the images of the physical body – the microcosm – may symbolically reproduce the central vulnerabilities and anxieties of the macrocosm – the 'social body'. In patriarchal systems, men's fears are readily transposed on to women, already seen as the 'other', against which they organise their identities. Women then become defined as inherently unstable, in danger of running out of containment, in contrast with rational, self-determining man.

What can be said about the role of hormones in our lives? This book explores the question by drawing from psychology, anthropology, sociology and the history of medicine, as well as from biology and medical sciences. The focus is on what scientists call 'behaviour' – on the claims made about the role of hormones in determining what we do, and how we think and feel. The aim is to examine the enduring appeal of images of humanity driven by internal chemicals. The pronouncements of modern science are inevitably framed by history, and by contemporary social concerns such as who is a suitable case for treatment.

A deeper understanding of the origins of current ideas about how hormones work may help us to regain a sense of connection with our bodies and our environment in the broadest sense – to appreciate the links between the way we are and the way we live, to look at our lives in context. Such empowerment will come only with the knowledge that in reality, collectively and individually, we are continually creating ourselves.