CHAPTER 11

—

What Is Addiction?

Addicts and addictions are part of our cultural landscape and lexicon. We all know who and what they are—or think we do. In this section of the book we'll look at the subject from a scientific perspective, beginning with a working definition of addiction. We also need to dispel some common misconceptions.

In the English language addiction has two overlapping but distinct meanings. In our day, it most commonly refers to a dysfunctional dependence on drugs or on behaviours such as gambling or sex or eating. Surprisingly, that meaning is only about a hundred years old. For centuries before then, at least back to Shakespeare, addiction referred simply to an activity that one was passionate about or committed to, gave one's time to. "Sir, what sciences have you addicted yourself to," someone asks the knight Don Quixote in an eighteenth-century English translation of the Cervantes classic. In the nineteenth-century *Confessions of an English Opium Eater,* Thomas De Quincey never once refers to his narcotic habit as an addiction, even if by our current definition it certainly was. The pathological sense of the word arose in the early twentieth century.

The term's original root comes from the Latin *addicere,* "assign to."* That yields the word's traditional, innocuous meaning: a habitual activity or interest, often with a positive purpose. The

* From *dicere* ("to say") and the prefix *ad-* ("to").

Victorian-era British politician William Gladstone wrote about "addiction to agricultural pursuits," implying a perfectly admirable vocation. But the Romans had another, more ominous usage that speaks to our present-day interpretation: an *addictus* was a person who, having defaulted on a debt, was assigned to his creditor as a slave—hence, addiction's modern sense as enslavement to a habit. De Quincey anticipated that meaning when he acknowledged "the chain of abject slavery" forged by his narcotic dependence.

What, then, is addiction? In the words of a consensus statement by addiction experts in 2001, addiction is a "chronic *neurobiological disease* . . . characterized by behaviors that include one or more of the following: impaired control over drug use, compulsive use, continued use despite harm, and craving."[1] The key features of substance addiction are the use of drugs or alcohol despite negative consequences, and relapse. I've heard some people shrug off their addictive tendencies by saying, for example, "I can't be an alcoholic. I don't drink that much . . ." or "I only drink at certain times." The issue is not the quantity or even the frequency, but the impact. "An addict continues to use a drug when evidence strongly demonstrates the drug is doing significant harm. . . . If users show the pattern of preoccupation and compulsive use repeatedly over time with relapse, addiction can be identified."[2]

Helpful as such definitions are, we have to take a broader view to understand addiction fully. There is a fundamental addiction process that can express itself in many ways, through many different habits. The use of substances like heroin, cocaine, nicotine and alcohol are only the most obvious examples, the most laden with the risk of physiological and medical consequences. Many behavioural, nonsubstance addictions can also be highly destructive to physical health, psychological balance, and personal and social relationships.

Addiction is any repeated behaviour, substance-related or not, in which a person feels compelled to persist, regardless of its negative impact on his life and the lives of others. Addiction involves:

1. compulsive engagement with the behaviour, a preoccupation with it;
2. impaired control over the behaviour;
3. persistence or relapse, despite evidence of harm; and
4. dissatisfaction, irritability or intense craving when the object—be it a drug, activity or other goal—is not immediately available.

Compulsion, impaired control, persistence, irritability, relapse and craving—these are the hallmarks of addiction—any addiction. Not all harmful compulsions are addictions, though: an obsessive-compulsive, for example, also has impaired control and persists in a ritualized and psychologically debilitating behaviour such as, say, repeated hand washing. The difference is that he has no craving for it and, unlike the addict, he gets no kick out of his compulsion.

How does the addict know she has impaired control? Because she doesn't stop the behaviour in spite of its ill effects. She makes promises to herself or others to quit, but despite pain, peril and promises, she keeps relapsing. There are exceptions, of course. Some addicts never recognize the harm their behaviours cause and never form resolutions to end them. They stay in denial and rationalization. Others openly accept the risk, resolving to live and die "my way."

As we shall see shortly, all addictions—whether to drugs or to nondrug behaviours—share the same brain circuits and brain chemicals. On the biochemical level the purpose of all addictions is to create an altered physiological state in the brain. This can be achieved in many ways, drug taking being the most direct. So an addiction is never purely "psychological"; all addictions have a biological dimension.

And here a word about dimensions. As we delve into the scientific research, we need to avoid the trap of believing that addiction can be reduced to the actions of brain chemicals or nerve circuits or any other kind of neurobiological, psychological or sociological data. A multilevel exploration is necessary because it's impossible to understand addiction fully from any one perspective, no matter how accurate. Addiction is a complex condition, a complex interaction between human beings and their environment. We need to view it simultaneously from many different angles—or, at least, while examining it from one angle, we

need to keep the others in mind. Addiction has biological, chemical, neurological, psychological, medical, emotional, social, political, economic and spiritual underpinnings—and perhaps others I haven't thought about. To get anywhere near a complete picture we must keep shaking the kaleidoscope to see what other patterns emerge.

—

Because the addiction process is too multifaceted to be understood within any limited framework, my definition of addiction made no mention of "disease." Viewing addiction as an illness, either acquired or inherited, narrows it down to a medical issue. It does have some of the features of illness, and these are most pronounced in hardcore drug addicts like the ones I work with in the Downtown Eastside. But not for a moment do I wish to promote the belief that the disease model by itself explains addiction or even that it's the key to understanding what addiction is all about. Addiction is "all about" many things.

Note, too, that neither the textbook definitions of drug addiction nor the broader view we're taking here includes the concepts of *physical dependence* or *tolerance* as criteria for addiction. Tolerance is an instance of "give an inch, take a mile." That is, the addict needs to use more and more of the same substance or engage in more and more of the same behaviour, to get the same rewarding effects. Although tolerance is a common effect of many addictions, a person does not need to have developed a tolerance to be addicted. And then there's physical dependence. As defined in medical terms, physical dependence is manifested when a person stops taking a substance and, due to changes in the brain and body, she experiences withdrawal symptoms. Those temporary, drug-induced changes form the basis of physical dependence. Although a feature of drug addiction, a person's physical dependence on a substance does not necessarily imply that he is addicted to it.

The withdrawal syndrome is different for each class of drug—in the case of opiates such as morphine or heroin it includes nausea, diarrhea, sweats, aches and pains and weakness, as well as severe anxiety, agitation and depressed mood. But you don't have to be

addicted to experience withdrawal—you just have to have been taking a medication for an extended period of time.[3] As many people have discovered to their chagrin, with abrupt cessation it's quite possible to suffer highly unpleasant withdrawal symptoms from drugs that are not addictive: the antidepressants paroxetine (Paxil) and venlafaxine (Effexor) are but two examples. Withdrawal does not mean you were addicted; for addiction, there also needs to be craving and relapse.

In fact, in the case of narcotics, it turns out that the addictive, "feel good" effect of these drugs seems to act in a different part of the brain than the effects that lead to physical dependence. When morphine is infused only into the "reward" circuits of a rat's brain, addiction-like behaviour results, but there's no physical dependence and no withdrawal.[4]

"Dependence" can also be understood as a powerful attachment to harmful substances or behaviours, and this definition gives us a clearer picture of addiction. The addict comes to depend on the substance or behaviour in order to make himself feel momentarily calmer or more excited or less dissatisfied with his life. That's the meaning I'll be referring to unless I am specifically describing *physical dependence*, the narrower medical phenomenon. Father Sam Portaro, author and former Episcopalian Chaplain to the University of Chicago, said it admirably well in a recent lecture: "The heart of addiction is dependency, excessive dependency, unhealthy dependency—unhealthy in the sense of unwhole, dependency that disintegrates and destroys."[5]

PART IV

How the Addicted Brain Develops

If our society were truly to appreciate the significance of children's emotional ties throughout the first years of life, it would no longer tolerate children growing up, or parents having to struggle, in situations that cannot possibly nourish healthy growth.

STANLEY GREENSPAN, M.D.
CHILD PSYCHIATRIST AND FORMER DIRECTOR, CLINICAL INFANT DEVELOPMENT PROGRAM, [U.S.] NATIONAL INSTITUTE OF MENTAL HEALTH

CHAPTER 17

Their Brains Never Had a Chance

My first book, *Scattered Minds*, published in 2000, dealt with attention deficit disorder, a condition I myself have. It so happens that ADD is a major risk factor for addiction to a number of substances, including nicotine, cocaine, alcohol, cannabis and crystal meth, and also for gambling and other behavioural addictions—but that's not why I'm mentioning the book here. Rather, I want to tell an anecdote from just before its publication.

In *Scattered Minds*, I had laid out some well-established research evidence showing that the mammalian brain develops largely under the influence of the environment, rather than according to strict genetic predetermination—and that this is especially the case with the human brain. These findings were relatively recent but by then wholly uncontroversial, at least in brain science circles. They were not obscure academic secrets but had been the subjects of cover articles in both *Time* and *Newsweek*.

I was speaking on the phone with a young producer who had called me from Toronto to discuss a possible studio interview on a national television program. We were going over what material I might present on the air. I was just getting into some of the more fascinating of the research points when she interrupted me. "Wait. You mean to tell me that the size of a mother's pupils and how she looks at her baby will affect the chemistry of the kid's brain?" "Not only

will it," I said, "it does so instantaneously!" I was on a roll, certain that this producer was just as enthralled as I with the insights of developmental neuroscience. "Over time, if there's a pattern of—"

"That's ridiculous," she said, interrupting a second time. "There's no way we can use that." And before I could ask her on what grounds she was rejecting the fruits of several decades of scientific investigation, she hung up.

That a TV producer, or any layperson for that matter, would have trouble accepting the new brain science is understandable, given the mind-body separation prevalent in our culture, and given, too, how long we've been taught that genes determine almost everything about a human being: personality traits, behaviour, eating patterns and all manner of disease. Much more perplexing is the fact that this new knowledge is virtually unfamiliar to the medical community. Despite the thousands of research papers published in leading scientific and medical journals, countless monographs and conference documents and several outstanding academic books on the subject, the role of the environment in brain development isn't taught in many medical schools.[1] It's not incorporated into our work with children or adults. Not only is brain development ignored in medical training, so is human psychological development. "It is astonishing to realize," remarks neurologist Antonio Damasio, "that [medical] students learn about psychopathology without ever being taught normal psychology."[2]

Such neglect is a loss for medical practice, and for millions of patients. Greater awareness of developmental influences on brain functioning and the personality would enrich and empower every field of medicine. And if more doctors knew what there is to know about this, I am convinced it would encourage a radical and overdue rethinking of social attitudes towards addiction.

Brain development in the uterus and during childhood is the single most important biological factor in determining whether or not a person will be predisposed to substance dependence and to addictive behaviours of any sort, whether drug-related or not. Startling as this view may appear to be at first sight, it is amply supported by recent research. Dr. Vincent Felitti was chief investigator in a landmark study of over seventeen thousand

middle-class Americans for Kaiser Permanente and the [U.S.] Centres for Disease Control. "The basic cause of addiction is predominantly experience-dependent during childhood, and not substance-dependent," Dr. Felitti has written. "The current concept of addiction is ill-founded."[3]

To state that childhood brain development has the greatest impact on addiction is not to rule out genetic factors. However, the emphasis placed on genetic influences in addiction medicine—and in many other areas of medicine—is an impediment to our understanding.

—

"The human brain, a 3-pound mass of interwoven nerve cells that controls our activity, is one of the most magnificent—and mysterious—wonders of creation. The seat of human intelligence, interpreter of senses, and controller of movement, this incredible organ continues to intrigue scientists and laymen alike."

With these words President George H.W. Bush inaugurated the 1990s as "the decade of the brain." In the United States there followed an inspiring expansion of research into the workings and development of the brain. When the findings were collated, together with previously available information, a fresh and exciting view of brain development emerged. Old assumptions were discarded and a new paradigm established. Many of the details remain to be discovered, of course—the work of centuries, suggests Professor Jaak Panksepp in *Affective Neuroscience*—but the outlines are not in doubt. The view that genes play a decisive role in the way a person's brain develops has been replaced by a radically different notion: *the expression of genetic potentials is, for the most part, contingent on the environment.* Genes do dictate the basic organization, developmental schedule and anatomical structure of the human central nervous system, but it's left to the environment to sculpt and fine-tune the chemistry, connections, circuits, networks and systems that determine how well we function.

Of all the mammals, we humans have the least mature brain at birth. Early in their infancy other newborn animals perform tasks far beyond the capabilities of human babies. A horse, for example,

can run on its first day of life. Not for a year and a half or more can most humans muster the muscle strength, visual acuity and neurological control skills—perception, balance, orientation in space, coordination—to perform that activity. In other words, the horse's brain development at birth is at least a year and a half ahead of our own—probably even more, in horse years.

Why are we saddled with such a disadvantage in comparison to a horse? We can think of it as a compromise imposed by Nature. Our evolutionary predecessors were permitted to walk upright, which freed forelimbs to evolve into arms and hands capable of many delicate and complicated activities. Those advances in manual versatility and dexterity required a tremendous enlargement of the brain, especially of its frontal areas. Our frontal lobes, which coordinate the movement of our hands, are much larger even than those of our closest evolutionary relative, the chimpanzee. These lobes, particularly their prefrontal areas, are also responsible for the problem solving, social and language skills that have allowed humankind to thrive. As we became a two-legged species, the human pelvis had to narrow to accommodate our upright stance. At the end of the nine months of human gestation the head forms the largest diameter of the body, the one most likely to get stuck in our journey through the birth canal. It's simple engineering: any further brain growth in the uterus and we couldn't be born.

To ensure that babies can make their way out of the birth canal, the bargain forced upon our ancestors was that the human brain would be relatively small and immature at birth. On the other hand, it would undergo tremendous growth outside the mother's body. In the period following birth, the human brain, unlike that of the chimpanzee, continues to grow at the same rate as in the womb. There are times in the first year of life when, every second, multiple millions of nerve connections, or synapses, are established. Three-quarters of our brain growth takes place outside the womb, most of it in the early years. By three years of age, the brain has reached 90 per cent of adult size, whereas the body is only 18 per cent of adult size.[4] This explosion in growth outside the womb gives us a far higher potential for learning and adaptability than is granted to other mammals. Were we born with our brain development rigidly

predetermined by heredity, the frontal lobes would be limited in their capacity to help us learn and adapt to the many different environments and social situations we humans now inhabit.

Greater reward demands greater risk. Outside the relatively safe environment of the womb, our brains-in-progress are highly vulnerable to potentially adverse circumstances. Addiction is one of the possible negative outcomes—although, as we will see when we discuss genetic influences, the brain can already be negatively affected in the uterus in ways that increase vulnerability to addiction and to many other chronic conditions that threaten health.

The dynamic process by which 90 per cent of the human brain's circuitry is wired after birth has been called "neural Darwinism" because it involves the selection of those nerve cells (neurons), synapses and circuits that help the brain adapt to its particular environment, and the discarding of others. In the early stages of life, the infant's brain has many more neurons and connections than necessary—billions of neurons in excess of what will eventually be required. This overgrown, chaotic synaptic tangle needs to be trimmed to shape the brain into an organ that can govern action, thought, learning and relationships and carry out its multiple and varied other tasks—and to coordinate them all in our best interests. Which connections survive depends largely on input from the environment. Connections and circuits used frequently are strengthened, while unused ones are pruned out: indeed, scientists call this aspect of neural Darwinism *synaptic pruning*. "Both neurons and neural connections compete to survive and grow," write two researchers. "Experience causes some neurons and synapses (and not others) to survive and grow."[5]

Through this weeding out of unutilized cells and synapses, the selection of useful connections and the formation of new ones, the specialized circuits of the maturing human brain emerge. The process is highly specific to each individual person—so much so that not even the brains of identical twins have the same nerve branching, connections and circuitry. In large part, an infant's early years define how well her brain structures will develop and how the neurological networks that control human behaviour will mature. "Developmental experiences determine the organizational and functional status of the

mature brain," writes child psychiatrist and researcher Bruce Perry.[6] Or in the words of Dr. Robert Post, chief of the Biological Psychiatry Branch of the [U.S.] National Institute of Mental Health: "At any point in this process you have all these potentials for either good or bad stimulation to get in there and set the microstructure of the brain."[7] And it is precisely here where the problem arises for young children who will, in adolescence and beyond, become chronically hooked on hard drugs: too much of what Dr. Post called bad stimulation. This is true of the hardcore intravenous drug users such as the ones I deal with in the Downtown Eastside. In many other cases it's not a question of "bad stimulation" but of a lack of sufficient "good stimulation."

Our genetic capacity for brain development can find its full expression only if circumstances are favourable. To illustrate this, just imagine a baby who was cared for in every way but kept in a dark room. After a year of such sensory deprivation the brain of this infant would not be comparable to those of others, no matter what his inherited potential. Despite perfectly good eyes at birth, without the stimulation of light waves, the thirty or so neurological units that together make up our visual sense would not develop. The neural components of vision already present at birth would atrophy and become useless if this child did not see light for about five years. Why? Neural Darwinism. Without the requisite stimulation during the critical period allotted by Nature for the visual system's development, the child's brain would never have received the information that being able to see is needed for survival. Irreversible blindness would be the result.

What is true for vision is also true for the dopamine circuits of incentive-motivation and the opioid circuitry of attachment-reward, as well as for the regulatory centres in the prefrontal cortex, such as the orbitofrontal cortex—in other words, for all the major brain systems implicated in addiction that we surveyed in the previous three chapters. In the case of these circuits, which process emotions and govern behaviour, it is the *emotional environment* that is decisive. By far the dominant aspect of this environment is the role of the nurturing adults in the child's life, especially in the early years.

The three environmental conditions absolutely essential to optimal human brain development are nutrition, physical security and consistent emotional nurturing. In the industrialized world, except in cases of severe neglect or dire poverty, the baseline nutritional and shelter needs of children are usually satisfied. The third prime necessity—emotional nurture—is the one most likely to be disrupted in Western societies. The importance of this point cannot be overstated: *emotional nurturance is an absolute requirement for healthy neurobiological brain development.* "Human connections create neuronal connections"—in the succinct phrase of child psychiatrist Daniel Siegel, a founding member of UCLA's Center for Culture, Brain and Development.[8] As we will soon see, this is particularly so for the brain systems involved in addiction. The child needs to be in an *attachment relationship* with at least one reliably available, protective, psychologically present and reasonably non-stressed adult.

Attachment, as we've already learned, is the drive to pursue and preserve closeness and contact with others; an attachment relationship exists when that state has been achieved. It's an instinctual drive programmed into the mammalian brain, owing to the absolute helplessness and dependency of infant mammals—particularly infant humans. Without attachment he cannot survive; without safe, secure and nonstressed attachment, his brain cannot develop optimally. Although that dependency wanes as we mature, attachment relationships remain important throughout our lifetime.

Daniel Siegel writes in *The Developing Mind*:

> For the infant and young child, attachment relationships are the major environmental factors that shape the development of the brain during its period of maximal growth . . . Attachment establishes an interpersonal relationship that helps the immature brain use the mature functions of the parent's brain to organize its own processes.[9]

To begin to grasp the matter, all we need to do is picture a child who was never smiled at, never spoken to in a warm and loving way,

never touched gently, never played with. Then we can ask ourselves: What sort of person do we envision such a child becoming?

Infants require more than the physical presence and attention of the parent. Just as the visual circuits need light waves for their development, the emotional centres of the infant brain, in particular the all-important orbitofrontal cortex (OFC), require healthy emotional input from the parenting adults. Infants read, react to and are developmentally influenced by the psychological states of the parents. They are affected by body language: tension in the arms that hold them, tone of voice, joyful or despondent facial expressions and, yes, the size of the pupils. In a very real sense, the parent's brain programs the infant's, and this is why stressed parents will often rear children whose stress apparatus also runs in high gear, no matter how much they love their child and no matter that they strive to do their best.

The electrical activity of the infant's brain is exquisitely sensitive to that of the nurturing adult. A study at the University of Washington in Seattle compared the brainwave patterns of two groups of six-month-old infants: one group whose mothers were suffering postpartum depression and one group whose mothers were in normal good spirits. Electroencephalograms, or EEGs, showed consistent, marked differences between the two groups: the babies of the depressed mothers had EEG patterns characteristic of depression *even during interactions with their mothers that were meant to elicit a joyful response*. Significantly, these effects were noted only in the frontal areas of the brain, where the centres for the self-regulation of emotion are located.[10] How does this pertain to brain development? Repeatedly-firing nerve patterns become wired into the brain and will form part of a person's habitual responses to the world. In the words of the great Canadian neuroscientist Donald Hebb, "cells that fire together, wire together." The infants of stressed or depressed parents are likely to encode negative emotional patterns in their brains.

The long-term effect of parental mood on the biology of the child's brain is illustrated by several studies showing that concentrations of the stress hormone cortisol are elevated in the children of clinically depressed mothers. At age three, the highest cortisol levels

were found in those children whose mothers had been depressed during the child's first year of life, rather than later.*[11] Thus we see that the brain is "experience-dependent." Good experiences lead to healthy brain development, while the absence of good experiences or the presence of bad ones distorts development in essential brain structures. Dr. Rhawn Joseph, a scientist at the Brain Research Laboratory in San Jose, California, explains it this way:

> [An] abnormal or impoverished rearing environment can decrease a thousand fold the number of synapses per axon [the long extension from the cell body that conducts electrical impulses toward another neuron], retard growth and eliminate billions if not trillions of synapses per brain, and result in the preservation of abnormal interconnections which are normally discarded over the course of development.[12]

Since the brain governs mood, emotional self-control and social behaviour, we can expect that the neurological consequences of adverse experiences will lead to deficits in the personal and social lives of people who suffer them in childhood, including, Dr. Joseph continues, "a reduced ability to anticipate consequences or to inhibit irrelevant or inappropriate, self-destructive behaviors."

Were these not exactly the dysfunctions we witnessed in Claire and Don in the previous chapter? It's what we see in all hardcore drug addicts.

We know that the majority of chronically hardcore substance-dependent adults lived, as infants and children, under conditions of severe adversity that left an indelible stamp on their development. Their predisposition to addiction was programmed in their early years. Their brains never had a chance.

* Such information ought to increase our respect for, and social and cultural support for, the parenting task. No one becomes depressed on purpose and, in my observation, depression in a new mother often reflects a lack of sufficient support in her environment.

CHAPTER 18

Trauma, Stress and the Biology of Addiction

The idea that the environment shapes brain development is a very straightforward one, even if the details are immeasurably complex. Think of a kernel of wheat. No matter how genetically sound a seed may be, factors such as sunlight, soil quality and irrigation must act on it properly if it is to germinate and grow into a healthy adult plant. Two identical seeds, cultivated under opposing conditions, would yield two different plants: one tall, robust and fertile; the other stunted, wilted and unproductive. The second plant is not diseased: it only lacked the conditions required to reach its full potential. Moreover, if it does develop some sort of plant ailment in the course of its life, it would be easy to see how a deprived environment contributed to its weakness and susceptibility. The same principles apply to the human brain.

The three dominant brain systems in addiction—the opioid attachment-reward system, the dopamine-based incentive-motivation apparatus and the self-regulation areas of the prefrontal cortex—are all exquisitely fine-tuned by the environment. To various degrees, in all addicted persons these systems are out of kilter. The same is true, we will see, of the fourth brain-body system implicated in addiction: the stress-response mechanism.

Happy, attuned emotional interactions with parents stimulate a release of natural opioids in an infant's brain. This endorphin surge promotes the attachment relationship and the further development

of the child's opioid and dopamine circuitry.[1] On the other hand, stress reduces the numbers of both opiate and dopamine receptors. Healthy growth of these crucial systems—responsible for such essential drives as love, connection, pain relief, pleasure, incentive and motivation—depends, therefore, on the quality of the attachment relationship. When circumstances do not allow the infant and young child to experience consistently secure interactions or, worse, expose him to many painfully stressing ones, maldevelopment often results.

Dopamine levels in a baby's brain fluctuate, depending on the presence or absence of the parent. In four-month-old monkeys major alterations of dopamine and other neurotransmitter systems were found after only six days of separation from their mothers. "In these experiments," writes Dr. Steven Dubovsky, "loss of an important attachment appears to lead to less of an important neurotransmitter in the brain. Once these circuits stop functioning normally, it becomes more and more difficult to activate the mind."[2]

We know from animal studies that social-emotional stimulation is necessary for the growth of the nerve endings that release dopamine and for the growth of receptors to which dopamine needs to bind in order to do its work. Even adult rats and mice kept in long-term isolation will have a reduced number of dopamine receptors in the midbrain incentive circuits and, notably, in the frontal areas implicated in addiction.[3] Rats separated from their mothers at an early stage display permanent disruption of the dopamine incentive-motivation system in their midbrains. As we already know, abnormalities in this system play a key role in the onset of addiction and craving. Predictably, in adulthood these maternally deprived animals exhibit a greater propensity to self-administer cocaine.[4] And it doesn't take extreme deprivation: in another study, rat pups deprived of their mother's presence for only one hour a day during their first week of life grew up to be much more eager than their peers to take cocaine on their own.[5] So the presence of consistent parental contact in infancy is one factor in the normal development of the brain's neurotransmitter systems; the absence of it makes the child more vulnerable to "needing" drugs of abuse later on to supplement what

her own brain is lacking. Another key factor is the *quality* of the contact the parent provides, and this, as we saw in the previous chapter, depends very much on the parent's mood and stress level.

All mammalian mothers—and many human fathers, as well—give their infants sensory stimulation that has long-term positive effects on their offspring's brain chemistry. Such sensory stimulation is so necessary for the human infant's healthy biological development that babies who are never picked up simply die. They stress themselves to death. Premature babies who have to live in incubators for weeks or months have faster brain growth if they are stroked for just ten minutes a day. When I learned such facts in the research literature, I recalled with appreciation a custom I had often observed among my Indo-Canadian patients during my years in family practice. As they were speaking with me during their early post-natal visits, these mothers would massage their babies all over their bodies, gently kneading them from feet to head. The infants were in bliss.

Humans hold and cuddle and stroke; rats lick. A 1998 study found that rats whose mothers had given them more licking and other kinds of nurturing contact during their infancy had, as adults, more efficient brain circuitry for reducing anxiety. They also had more receptors on their nerve cells for benzodiazepines, which are natural tranquilizing chemicals found in the brain.[6] I think here of my many patients who, on top of cocaine and heroin addictions, have been hooked since their adolescence on street-peddled "benzo" drugs like Valium to calm their jangled nervous systems. For a dollar a tablet, they get an artificial hit of the benzodiazepines their own brains can't supply. Their need for tranquilizers says much about their infancy and early childhood.

Parental nurturing determines the levels of other key brain chemicals, too—including serotonin, the mood messenger enhanced by antidepressants like Prozac. Peer-reared monkeys, separated from their mothers in laboratory experiments, have lower lifelong levels of serotonin than monkeys brought up by their mothers. In adolescence these same monkeys are more aggressive and are far more likely to consume alcohol in excess.[7] We see similar effects with other neurotransmitters that are

essential in regulating mood and behaviour, such as norepinephrine.[8] Even slight imbalances in the availability of these chemicals are manifested in aberrant behaviours like fearfulness and hyperactivity, and increase the individual's sensitivity to stressors for a lifetime. In turn, such acquired traits increase the risk of addiction.

Another effect of early maternal deprivation appears to be a permanent decrease in the production of oxytocin,* which, as mentioned in Chapter 14, is one of our love chemicals.[9] It is critical to our experience of loving attachments and even to maintaining committed relationships. People who have difficulty forming intimate relationships are at risk for addiction; they may turn to drugs as "social lubricants."

Not only can early childhood experience lead to a dearth of "good" brain chemicals; it can also result in a dangerous overload of others. Maternal deprivation and other types of adversity during infancy and childhood result in chronically high levels of the stress hormone cortisol. In addition to damaging the midbrain dopamine system, excess cortisol shrinks important brain centres such as the hippocampus—a structure important for memory and for the processing of emotions—and disturbs normal brain development in many other ways, with lifelong repercussions.[10] Another major stress chemical that's permanently overproduced after insufficient early maternal contact is vasopressin, which is implicated in high blood pressure.[11]

A child's capacity to handle psychological and physiological stress is completely dependent on the relationship with his parent(s). Infants have no ability to regulate their own stress apparatus, and that's why they will stress themselves to death if they are never picked up. We acquire that capacity gradually as we mature—or we don't, depending on our childhood relationships with our caregivers. A responsive, predictable nurturing adult plays a key role in the development of our healthy stress-response neurobiology.[12]

* As noted earlier, oxytocin is not an opioid. Therefore, it has no relationship whatsoever with narcotic drugs like Oxycet or OxyContin; only the names are similar.

In the words of one researcher, "maternal contact alters the neurobiology of the infant."* [13] Children who suffer disruptions in their attachment relationships will not have the same biochemical milieu in their brains as their well-attached and well-nurtured peers. As a result their experiences and interpretations of their environment, and their responses to it, will be less flexible, less adaptive and less conducive to health and maturity. Their vulnerability will increase, both to the mood-enhancing effect of drugs and to becoming drug dependent. We know from animal studies, for example, that early weaning can have an influence on later substance intake: rat pups weaned from their mothers at two weeks of age had, as adults, a greater propensity to drink alcohol than pups weaned just one week later.[14]

—

The statistics that reveal the typical childhood of the hardcore drug addict have been reported widely but, it seems, not widely enough to have had the impact they ought to on mainstream medical, social and legal understandings of drug addiction.

Studies of drug addicts repeatedly find extraordinarily high percentages of childhood trauma of various sorts, including physical, sexual and emotional abuse. One group of researchers was moved to remark that "our estimates . . . are of an order of magnitude rarely seen in epidemiology and public health."[15] Their research, the renowned Adverse Childhood Experiences (ACE) Study, looked at the incidence of ten separate categories of painful circumstances—including family violence, parental divorce, drug or alcohol abuse in the family, death of a parent and physical or sexual abuse—in thousands of people. The correlation between these figures and substance abuse later in the subjects' lives was then calculated. For each adverse childhood experience, or ACE, the risk for the early initiation of substance abuse increased two to four times. Subjects

* In the human context "maternal" does not necessarily refer to a female mothering figure or to a biological parent. It can also refer to primary caregivers of either gender.

with five or more ACEs had seven to ten times greater risk for substance abuse than those with none.

The ACE researchers concluded that nearly two-thirds of injection drug use can be attributed to abusive and traumatic childhood events—and keep in mind that the population they surveyed was a relatively healthy and stable one. A third or more were college graduates, and most had at least some university education. With my patients, the childhood trauma percentages would run close to one hundred. Of course, not all addicts were subjected to childhood trauma—although most hardcore injection users were—just as not all severely abused children grow up to be addicts.

According to a review published by the [U.S.] National Institute on Drug Abuse in 2002, "the rate of victimization among women substance abusers ranges from 50% to nearly 100% . . . Populations of substance abusers are found to meet the [diagnostic] criteria for post-traumatic stress disorder . . . those experiencing both physical and sexual abuse were at least *twice* as likely to be using drugs than those who experienced either abuse alone."[16] Alcohol consumption has a similar pattern: those who had suffered sexual abuse were three times more likely to begin drinking in adolescence than those who had not. For each emotionally traumatic childhood circumstance, there is a two- to-threefold increase in the likelihood of early alcohol abuse. "Overall, these studies provide evidence that stress and trauma are common factors associated with consumption of alcohol at an early age as a means to self-regulate negative or painful emotions,"[17] write the ACE researchers.

It's just as many substance addicts say: they self-medicate to soothe their emotional pain—but more than that, their brain development was sabotaged by their traumatic experiences. The systems subverted by addiction—the dopamine and opioid circuits, the limbic or emotional brain, the stress apparatus and the impulse-control areas of the cortex—just cannot develop normally in such circumstances.

We know something about how specific kinds of childhood trauma affect brain development. For example: the vermis, a part of the cerebellum at the back of the brain, is thought to play a key role in addictions because it influences the dopamine system in the

midbrain. Imaging of this structure in adults who were sexually abused as children reveals abnormalities of blood flow, and these abnormalities are associated with symptoms that increase the risk for substance addiction.[18] In one study of the EEGs of adults who had suffered sexual abuse, the vast majority had abnormal brain-waves, and over a third showed seizure activity.[19]

These findings brought to mind a thirteen-year-old girl in my family practice who, apparently out of the blue, began to experience epileptic symptoms in the form of "absence spells." She would completely "zone out" for brief periods of time. Once, on a baseball diamond, she stared glassy-eyed and immobile, completely deaf to her teammates' shouts to swing the bat. She had similar spells in the classroom, lasting up to ten or twenty seconds. Her EEG was abnormal and the neurologist I consulted prescribed anticonvulsant medication. When I asked her in the privacy of my office if anything was stressing her, she simply said, "No."

Nine years later, no longer epileptic, she revealed to me that her seizures had begun during a period of repeated sexual abuse by a family member. Typically for sexually abused children, she felt there was no one to turn to for help, so she "absented" herself instead.

It gets worse. The brains of mistreated children have been shown to be smaller than normal by 7 or 8 per cent, with below-average volumes in multiple brain areas, including the impulse-regulating prefrontal cortex; in the corpus callosum (CC), the bundle of white matter that connects and integrates the functioning of the two sides of the brain; and in several structures of the limbic or emotional apparatus, whose dysfunctions greatly increase vulnerability to addiction.[20] In a study of depressed women who had been abused in childhood, the hippocampus (the memory and emotional hub) was found to be 15 per cent smaller than normal. The key factor was abuse, not depression, since the same brain area was unaffected in depressed women who had not been abused.[21]

I mentioned abnormalities in the corpus callosum, which facilitates the collaboration between the brain's two halves, or hemispheres. Not only have the CCs of trauma survivors been shown to be smaller, but there is evidence of a disruption of functioning there as well. The result can be a "split" in the processing of emotion: the two halves may

not work in tandem, particularly when the individual is under stress. One characteristic of personality disorder, a condition with which substance abusers are very commonly diagnosed, is a kind of flip-flopping between idealization of another person and intense dislike, even hatred. There is no middle ground, where both the positive and the negative qualities of the other are acknowledged and accepted.

Dr. Martin Teicher, Director of the Developmental Biopsychiatry Research Program at McLean Hospital in Maryland, suggests the very intriguing possibility that our "negative" views of a person are stored in one hemisphere and our "positive" responses, in the other. The lack of integration between the two halves of the brain would mean that information from the two views, negative and positive, is not melded into one complete picture. As a result, in intimate relationships and in other areas of life, the afflicted individual fluctuates between idealized and degraded perceptions of himself, other people and the world.[22] This sensible theory, if proven, would explain a lot not only about drug-dependent persons, but also about many behavioural addicts.

Here I must admit to a shudder of recognition. I sometimes operate as if I were two different people: my view of things can be either very positive or highly cynical and pessimistic, and often dogmatically so. When I'm watching the happy channel, my negative perceptions seem like a crazy dream; when stuck in the dejected mode I can't recall ever having felt joy.

Of course, the moods and perceptions of my drug-addicted patients swing on pendulums far wilder and more erratic than mine. To some extent these extreme oscillations must be drug induced, but they also reflect the faulty brain dynamics that resulted from my patients' uniformly miserable childhood histories. Extreme circumstances breed extremist brains.

Such differences between a behavioural addict like me and the hardcore Skid Row addicts may place us worlds apart in social functioning and status, but the point remains that the chronic injection drug user is only at the far end of a continuum. Milder disruptions in early childhood experience and brain development can and do occur, and often result in "milder" forms of substance use or in non-drug, behavioural addictions.

Early trauma also has consequences for how human beings respond to stress all their lives, and stress has everything to do with addiction. It merits a brief look here.

Stress is a physiological response mounted by an organism when it is confronted with excessive demands on its coping mechanisms, whether biological or psychological. It is an attempt to maintain internal biological and chemical stability, or *homeostasis*, in the face of these excessive demands. The physiological stress response involves nervous discharges throughout the body and the release of a cascade of hormones, chiefly adrenaline and cortisol. Virtually every organ is affected, including the heart and lungs, the muscles and, of course, the emotional centres in the brain. Cortisol itself acts on the tissues of almost every part of the body—from the brain to the immune system, from the bones to the intestines. It is an important part of the infinitely intricate system of checks and balances that enables the body to respond to a threat.

At a conference in 1992 at the U.S. National Institutes of Health, researchers defined stress "as a *state of disharmony or threatened homeostasis*."[23] According to such a definition, a stressor "is *a threat, real or perceived, that tends to disturb homeostasis*."[24] What do all stressors have in common? Ultimately they all represent the absence of something that the organism perceives as necessary for survival—or its threatened loss. The threat itself can be real or perceived. The threatened loss of food supply is a major stressor. So is the threatened loss of love—for human beings. "It may be said without hesitation that for man the most important stressors are emotional," wrote the pioneering Canadian stress researcher and physician Hans Selye.[25]

Early stress establishes a lower "set point" for a child's internal stress system: such a person becomes stressed more easily than normal throughout her life. Dr. Bruce Perry is Senior Fellow at the Child Trauma Academy in Houston, Texas, and the former Director of Provincial Programs for Children's Mental Health in Alberta. As he points out, "A child who is stressed early in life will be more overactive and reactive. He is triggered more easily, is more anxious and distressed. Now, compare a person—child, adolescent or adult—

whose baseline arousal is normal with another whose baseline state of arousal is at a higher level. Give them both alcohol: both may experience the same intoxicating effect, but the one who has this higher physiological arousal will have the added effect of feeling pleasure from the relief of that stress. It's similar to when with a parched throat you drink some cool water: the pleasure effect is much heightened by the relief of thirst."[26]

The hormone pathways of sexually abused children are chronically altered.[27] Even a relatively "mild" stressor such as maternal depression—let alone neglect, abandonment or abuse—can disturb an infant's physical stress mechanisms.[28] Add neglect, abandonment or abuse, and the child will be more reactive to stress throughout her life. A study published in *The Journal of the American Medical Association* concluded that "a history of childhood abuse per se is related to increased neuroendocrine [nervous and hormonal] stress reactivity, which is further enhanced when additional trauma is experienced in adulthood."[29]

A brain pre-set to be easily triggered into a stress response is likely to assign a high value to substances, activities and situations that provide short-term relief. It will have less interest in long-term consequences, just as people in extremes of thirst will greedily consume water knowing that it may contain toxins. On the other hand, situations or activities that for the average person are likely to bring satisfaction are undervalued because, in the addict's life, they have not been rewarding—for example, intimate connections with family. This shrinking from normal experience is also an outcome of early trauma and stress, as summarized in a recent psychiatric review of child development:

> Neglect and abuse during early life may cause bonding systems to develop abnormally and compromise capacity for rewarding interpersonal relationships and commitment to societal and cultural values later in life. Other means of stimulating reward pathways in the brain, such as drugs, sex, aggression, and intimidating others, could become relatively more attractive and less constrained by concern about violating trusting relationships. The ability to modify behavior based on negative experiences may be impaired.[30]

Hardcore drug addicts, whose lives invariably began under conditions of severe stress, are all too readily triggered into a stress reaction. Not only does the stress response easily overwhelm the addict's already challenged capacity for rational thought when emotionally aroused, but also the hormones of stress "cross-sensitize" with addictive substances. The more one is present, the more the other is craved. Addiction is a deeply ingrained response to stress, an attempt to cope with it through self-soothing. Maladaptive in the long term, it is highly effective in the short term.

Predictably, stress is a major cause of continued drug dependence. It increases opiate craving and use, enhances the reward efficacy of drugs and provokes relapse to drug-seeking and drug-taking.[31] "Exposure to stress is the most powerful and reliable experimental manipulation used to induce reinstatement of alcohol or drug use," one team of researchers reports.[32] "Stressful experiences," another research group points out, "increase the vulnerability of the individual to either develop drug self-administration or relapse."[33]

Stress also diminishes the activity of dopamine receptors in the emotional circuits of the forebrain, particularly in the nucleus accumbens, where the craving for drugs increases as dopamine function decreases.[34] The research literature has identified three factors that universally lead to stress for human beings: *uncertainty, lack of information and loss of control.*[35] To these we may add *conflict that the organism is unable to handle* and *isolation from emotionally supportive relationships*. Animal studies have demonstrated that isolation leads to changes in brain receptors and increased propensity for drug use in infant animals, and in adults reduces the activity of dopamine-dependent nerve cells.[36,37] Unlike rats reared in isolation, rats housed together in stable social groupings resisted cocaine self-administration—in the same way that Bruce Alexander's tenants in Rat Park were impervious to the charms of heroin.[38]

Human children do not have to be reared in physical isolation to suffer deprivation: emotional isolation will have the same effect, as does stress on the parent. As we will later see, stress on pregnant mothers has a negative impact on dopamine activity in the brain of the unborn infant, an impact that can last well past birth.

—

Some people may think that addicts invent or exaggerate their sad stories to earn sympathy or to excuse their habits. In my experience, the opposite is the case. As a rule, they tell their life histories reluctantly, only when asked and only after trust has been established—a process that may take months, even years. Often they see no link between childhood experiences and their self-harming habits. If they speak of the connection, they do so in a distanced manner that still insulates them against the full emotional impact of what happened.

Research shows that the vast majority of physical and sexual assault victims do not spontaneously reveal their histories to their doctors or therapists.[39] If anything, there is a tendency to forget or to deny pain. One study followed up on young girls who had been treated in an emergency ward for proven sexual abuse. When contacted seventeen years later as adult women, 40 per cent of these abuse victims either did not recall or denied the event outright. Yet their memory was found to be intact for other incidents in their lives.[40]

Addicts who do remember often blame themselves. "I was hit a lot," says forty-year-old Wayne, "but I asked for it. Then I made some stupid decisions." (Wayne is the one who sometimes greets me with the bluesy chant "Doctor, doctor, gimme the news . . ." when I'm doing my rounds between the Hastings Street hotels.) And would he hit a child, I inquire, if that child "asked for it"? Would he blame that child for "stupid decisions"? Wayne looks away. "I don't want to talk about that crap," says this tough man, who has worked on oil rigs and construction sites and served fifteen years in jail for armed robbery. He looks away and wipes his eyes.

—

Grasping the powerful impact of the early environment on brain development may leave us feeling hopelessly gloomy about recovery from addiction. It so happens there are solid reasons not to despair. Our brains are resilient organs: some important circuits continue to develop throughout our entire lives, and they may do so even in the

case of a hardcore drug addict whose brain "never had a chance" in childhood. That's the good news, on the physical level. Even more encouraging, we will find later that we have something in or about us that transcends the firing and wiring of neurons and the actions of chemicals. The mind may reside mostly in the brain, but it is much more than the sum total of the automatic neurological programs rooted in our pasts. And there is something else in us and about us: it is called by many names, "spirit" being the most democratic and least denominational or divisive in a religious sense. Later in this book, we will also examine its powerful transformational role.

As we conclude our tour of addiction's biological bases, however, we need to deal more directly with a topic I've already alluded to: the role of genes. Contrary to popular misconception, the truth about addiction is far from set in chromosomal stone; more good news, as we shall see presently.

CHAPTER 19

—

It's Not in the Genes

In 1990, newspapers and broadcast outlets across North America reported that researchers at the University of Texas had identified the gene for alcoholism. This news was greeted with tremendous interest, and the major media waxed enthusiastic with pronouncements about the imminent end of alcoholism. *Time* magazine was among the foremost cheerleaders:

> The benefits from this line of research may be huge. In five years, scientists should have perfected a blood test for the gene, to help spot children at risk. And within a decade, doctors may have in hand a drug that either blocks the gene's action or controls some forms of alcoholism by altering the absorption of dopamine. Eventually, with genetic engineering, experts may find a way to eliminate altogether the suspect gene from affected individuals.[1]

The researchers in question had never made the claim that they had discovered *the* "alcoholism gene," but they came close to making it. Some of their public statements fed that mistaken impression. Six years later the lead scientist, pharmacologist Kenneth Blum, published a much more subdued assessment:

> Unfortunately it was erroneously reported that [we] had found the "alcoholism gene," implying that there was a one-to-one relation