Aphrodisiacs, amphetamines, opiates—
these are some of the love potions that nature uses to get partners addicted to each other

HOOKED ON LOVE

BY RUTH WINTER AND KATHLEEN McAULIFFE

If you know anyone who is color-blind," says sexologist John Money, "then you have a good idea of what it means to be love-blind." Head of the psychohormonal unit of Johns Hopkins University, in Baltimore, Money is referring to a condition caused when the pituitary gland malfunctions early in life, triggering hormonal deficiencies. Since 1951 he has treated this problem in 27 patients, all of whom he describes as being psychosexually normal except that they are "unable to fall head over heels in love." These individuals are sociable, form friendships, and may occasionally marry for companionship. But according to Money, they cannot experience intense romantic passions any more than the color-blind can perceive certain hues. In fact, giddy crushes and heartaches are feelings so foreign to his patients that most are unaware that they are different from other people, until subjected to special tests.

Love-blindness is just one of a broad spectrum of romantic problems now believed to result—at least in part—from chemical instabilities in the brain. In recent years psychiatrists have begun to suspect that neurohormonal imbalances can contribute to such widespread troubles of the heart as lovesickness, separation anxiety, and obsessive infatuations. Indeed, early clinical trials suggest that certain romantically disturbed individuals can benefit enormously from drug therapies designed to stabilize their moods.

What makes some people love-blind and others love crazed? The chemistry of love carries mystical connotations—and so it should. Scientists will never succeed in reducing physical attraction to a neat set of chemical formulas. But they are beginning to iden-

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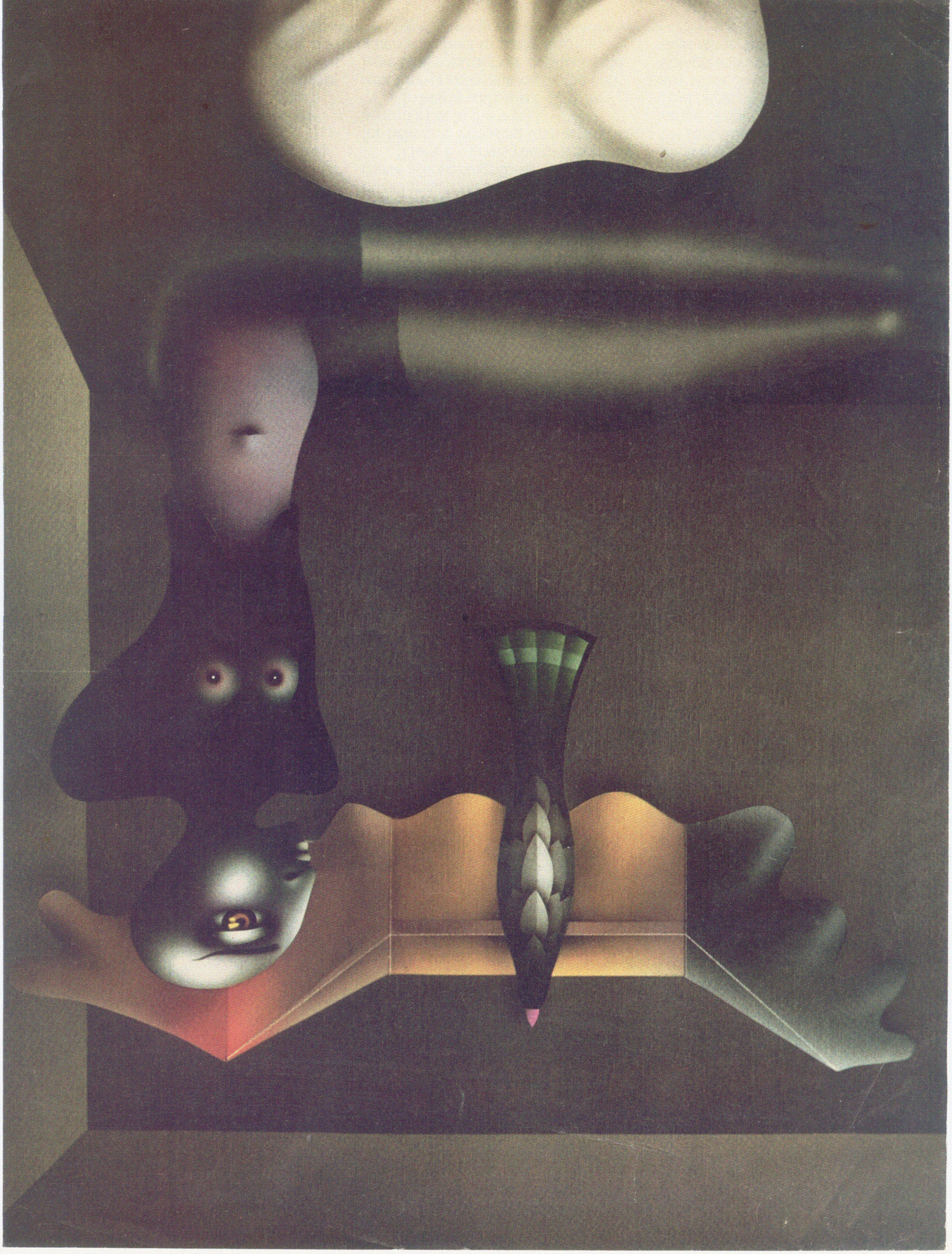

tify some of Mother Nature's love potions and the sorcery she uses to get us hooked on each other. Among other things, their research hints that this supreme matchmaker uses aphrodisiacs, amphetamine-like compounds, and opiates to lure people together, arouse sexual desire, and keep partners in a state of pair-bonded attraction long after the flames of passion have cooled. In the end the difference between the love-blind and the love crazed may be a matter of chemical addiction.

The scientific study of love must begin with the pituitary gland and a closely associated region at the base of the brain, the hypothalamus. Up until a decade ago the pituitary was considered the body's master gland, releasing hormones that indirectly affect sexual desire and behavior. But that view changed in the Seventies with the revelation that the hypothalamus was the real chemical boss in the body. No bigger than a pea, this miraculous region of the brain receives input from all over the body and transmits its instructions to the pituitary in the form of chemicals called releasing factors. These substances stimulate the pituitary to release its various hormones, which in turn affect the sex glands' production of hormones—estrogen and progesterone from the female ovary and androgens from the Leydig's cells of the male testes.

As Money reports, the love-blind suffer from an impairment of two vital neuropathways in this system—damage incurred before birth or later in life. The first neuropathway, which connects the hypothalamus to the pituitary, tells the pituitary when to release hormones. The second connects the hypothalamus to the higher-thinking and knowing part of the brain and tells the animal when to initiate the appropriate mating behavior. Consequently, this impairment is known in medical circles by the jawbreaking name hypopituitarism.

The biochemical switchboard of the hypopituitary system clearly is critical to human bonding. Even the olfactory center of the cerebrum conveys electrical signals—after one intermediate stop—to the hypothalamus. So even this part of the brain may be involved in such subtle aspects of sexuality as the ability to respond to the subliminal scent messages of others. Although pheromones were once thought to be the sex bait of insects only, new evidence indicates that smell is also part of the courtship language of reptiles, birds, fish, and mammals, including primates.

When you see someone of the opposite sex whom you find attractive and who finds you attractive, you may be exchanging barely perceptible olfactory cues—even across a crowded room. The existence of human pheromones, while still debated, has gained support with the discovery of apocrine glands—narrow pits at the base of hair follicles that produce an as-yet-unidentified scent chemical. Our underarm and genital hair is designed to collect this odor. As with all other mammals, human apocrines are small until puberty.

In an experiment at the University of North Carolina, both male and female partners engaged in more frequent sex after they had received topical applications of synthetic vaginal scents. A synthetic male pheromone, the researchers speculate, would have a similar impact on the couples' sexual behavior.

No one knows to what extent the odors we release are unique to each individual. But West German biologists showed that blindfolded men and women could identify the perspiration of their mates. In a similar study, Japanese women labeled the odors of their mates more unpleasant than their own, proving that smelliness does not necessarily add up to sexiness. The scientists involved in the latter study hypothesized that the reason for the strong Japanese aversion to body odor may be because their marriages were arranged. Perhaps related to this finding is the observation that among couples in Japan, lack of male sex drive is reported to be far more prevalent than in the United States.

'Men and women may exchange barely perceptible olfactory cues by means of special glands at the base of pubic hairs that produce scent chemicals.'

Though the influence of scents on human behavior is often barely discernible at a conscious level, other sex stimulants are known to produce more dramatic effects. At present, the greatest interest surrounds the recent discovery of a hypothalamic chemical that some scientists have dubbed the ultimate aphrodisiac. Called LHRH (for luteinizing-hormone releasing hormone), it was initially thought to be involved only in triggering the pituitary's release of sex-gland stimulating hormones. But in rats, LHRH was shown to function as a sex stimulant even when the animals' sex glands had been removed. To Robert L. Moss, a professor of physiology and neurology at the University of Texas Health Science Center, in Dallas, this suggests that the compound acts not only upon the pituitary to produce endocrine changes, but must also stimulate the brain directly.

As he observes, "We can take away a rat's ovaries and pituitary gland, inject as little as ten billionths of a gram of LHRH into its brain, along with a minimum amount of estrogen as a primer, and the animal will engage in sexual behavior for as long as eight hours at a stretch."

Human studies with LHRH have not yielded such spectacular—or, for that matter, clear-cut—results. It is worth noting, however, that early clinical trials have been restricted mostly to men suffering from secondary—usually stress-related—impotence. For example, Moss administered LHRH to 50 impotent men. The result: About 60 percent showed some positive effect on their sexual functioning.

"The spectrum of improvement ranged from very slight to dramatic," says Moss. "Some men simply reported feeling sexy and then obtained an erection several hours later. Others became very sexually aroused, obtaining an erection almost immediately after the injection." Moss also reports that the duration of the LHRH-induced response varies tremendously. Some studies indicate sexual arousal is dependent on continual administration of the drug, and others have demonstrated more long-lasting effects.

Another question left unresolved is whether LHRH produces a state of sexual arousal per se or a more generalized state of arousal. To find out, Moss and senior research associate Carol A. Dudley placed a female rat in the center of a maze, out of which radiated several runways. "At the end of one runway," explains Moss, "is a sexually active male; at another, a castrated male; and at still another, a female. If the female in the experiment has been injected with LHRH, she invariably runs right to the sexually active male. When she has not been injected, she doesn't make any particular choice. That tells us that the effects of LHRH are highly specific for sexual behavior. In fact, I know of no other brain chemical that can produce such a narrowly specified response."

Interestingly, in animals, LHRH seems to be responsible for synchronizing the behavioral and endocrinological aspects of mating; so it produces sexual arousal of the brain prior only to ovulation, when the female is most receptive to impregnation. In people, however, no such synchrony is apparent. This difference may well explain why human beings are the sexiest creatures on Earth, virtually alone among species in their freedom to engage in sex all the time, irrespective of reproductive considerations or seasonal changes.

In the book *The Sex Contract: The Evolution of Human Behavior*, anthropologist Helen E. Fisher offers one plausible explanation for what brought about our biochemical emancipation. When our ancestors chose to walk upright, she points out, an often-forgotten by-product of this anatomical revolution was the shrinkage of the birth canal by one, or even two, major diameters. The only protohominids that appear to have gotten around this obstetrical problem were those who gave birth to more immature infants. But this in turn produced another difficulty. The helplessness of the young meant that females now needed full-

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a frustration started to enter my life. How do you channel all this energy and drive that we had?" Duke took on a Coors distributorship in San Antonio, Texas. He did very well and then sold it. Now "blessed financially," as he puts it, Duke lives near San Antonio, manages his investments, and works on military recruitment.

It was his wife who changed first. "She opened her heart to the Lord, and that really set her free." And as a favor to her, Duke went to a Bible-study group, where he made a decision that Jesus was real and that he would follow the Bible. "It's the manufacturer's handbook."

"About eight months after I'd become a Christian, one night I woke up, and I felt this strong presence in my room. It was almost overpowering. I felt a hand on my shoulder pulling me out of bed. I got up and went into the next room and knelt down, and my hands went up in surrender to God. It was just, 'Lord, I surrender.' "

Duke realized later that "the Lord Jesus exploded in my life" that night. Since then he has prayed for the sick, laying on hands as the Bible directs. "God healed a cancer in a friend of ours," Duke says, "and then I watched Him open the eyes of a blind girl as we prayed for these people."

Duke travels with two businessmen to visit "leaders of nations"—the Sandinistas in Nicaragua; the presidents of Honduras, Guatemala, Germany, and Austria; Indira Gandhi; and Ferdinand Marcos in the Philippines. His mission is peace, "but not in the world sense of the absence of war. Peace with God is the message we bring."

What must they think of him, the Marxist revolutionaries, listening to a U.S. Air Force general talk about God? And what did Indira Gandhi think, when he talked about Jesus in a land of half a billion Hindus?

Duke is a Biblical literalist. He tells everyone that only through Jesus is there salvation. You can't get to heaven just by being a good person if you are a Buddhist, a Hindu, a Jew, or a Shiite Moslem.

Duke used to be less convinced. He was also an evolutionist, he says, but now that has changed, and he believes the Bible's account of creation. His message is shared "with love," but the way is the way.

Duke starts to quote Scripture. His tone is soft; he is almost whispering. But the intensity hasn't lessened. When he talks about weeping before high-school students and God needing a humble servant, he says, "If you're willing to be used by Him, he will destroy the pride.

"I mean, I don't particularly like crying in front of audiences, but it's like Jeremiah the prophet says, 'The word of God is shut up in my heart; it's burning like a fire. It's shut up in my bones. I am weary of holding it in, indeed I cannot.' "

Duke, the tenth man to have walked on the moon, could have stepped straight out of a pulpit in a fundamentalist church 50 years ago. And according to him, what he has now far surpasses what he had as an astronaut: "For six years afterward I walked around saying, 'Gosh, I could live for a thousand years and never have an experience like walking on the moon.' But that's not true, because I had an experience with the living God. The experience with Him . . . is so much more fantastic that the walk on the moon is like the dust in my life."

Did the moon do it? Does just going to the moon turn your life around? Obviously not. Not all the moonwalkers share the same experiences. But Irwin says he has seen a great change in all of the men who walked on the moon, whether they talk about it or not. And the biggest change, he thinks, is in the five lunar-module pilots, men who he says had fewer duties and more time to observe and think. Aldrin, who suffered a breakdown, was one of them. Bean, the painter, another. Bean says that having been to the moon gave him the confidence to try for a place in art history. Duke, of course, says the moon trip didn't do a thing to him, although both Mitchell and Irwin suggest there might have been a delayed effect.

How does the moon do it? Irwin says it may just be the contrast—"the lifelessness of the moon versus the place where life abounds, the earth"—that makes you think deeply about your life and life in general.

The moon shots have faded in memory now; even the image of the earth from space seems remote. Most of the Apollo astronauts' names are remembered only dimly. The Apollo program did change the place of the moon in the public mind. Once an object of mystery, the moon has become a symbol for the failure of technology to give us what we want. "They can send a man to the moon, but they can't . . . " Finish the sentence yourself.

And it wasn't only the public that the moon shots didn't satisfy. Irwin's wife wrote a book called *The Moon Is Not Enough*. Well, of course it's not, when you think about it. You can't live life on a memory, even if it's a memory of walking on the moon. Maybe it's not the moon that makes the change, but coming back to Earth.

That must be particularly true if you are the sort of man who had the drive to get there in the first place. Besides, being an astronaut—even a moonwalker—isn't what it used to be. Irwin, at the luncheon, was greeted by one of the organizers as Colonel *Irvin*. And when Duke spoke at Northeastern, there were only five people in the auditorium when he was ready to start. Something had gone wrong with the publicity or the students, and the officers with Duke had to shanghai students from the halls to bring the audience up to about 25. No wonder the moon isn't enough.

But Duke took it in stride. Like Irwin and Mitchell, he has found something to match or surpass the moon. "You know, if I drop dead right now I know that I'm going to be in heaven. If you ever hear that Charlie Duke's dead, say 'Glory, Hallelujah, he's in heaven.' "

Higher even than the moon. ∞

LOVE

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time mates to help them out. How was this problem finally resolved?

If Fisher is correct, females lured males into domesticity by offering them sex on a regular basis. The anthropologist notes that female primates in heat are extremely popular with males, who attend to them regularly and, in the case of chimpanzees, even provide them with more food than nonestrous females get. So natural selection, Fisher argues, would have favored females who maintained sexual drive beyond their estrus cycles.

Translated into biochemical terms, Fisher seems to be proposing that women evolved brains that could be activated by LHRH even when they weren't ovulating. And this is in fact exactly what Moss thinks has happened: "As you move up the evolutionary scale," he reports, "there is a tendency for LHRH brain arousal to be less rigidly controlled by hormonal feedback from the ovaries. That's the reason why a spayed cat loses its sex drive, while a woman who has had her ovaries removed feels no less sexy than a woman with her reproductive organs intact."

Though seldom noted, it is clear that human intercourse started to become distinct from procreation long before the invention of birth control. And in the process, our brains seem to have developed much more complex thoughts and feelings associated with the act of sex. For many human beings, an important prerequisite for physical intimacy is being in love—a state of mind that encompasses many more emotions than simply feeling sexy.

"A giddy high similar to an amphetamine boost inevitably accompanies the state of falling in love," observes Dr. Michael R. Liebowitz, of the New York State Psychiatric Institute. "But with continued intimacy the novelty of the relationship wears off, and the initial feeling of elation usually gives way to new emotions that serve to cement the tie between partners. At this stage, the presence of a loved one no longer heightens arousal but has a calming influence, inducing a sense of general well-being."

Liebowitz believes these two phases of romance, which he calls attraction and attachment, are for the most part biologically determined and involve two distinct neurochemical systems. He developed this theory over the course of clinical practice, when he noted that patients obsessed by love often appeared to have an imbalance in either neurosystem. He theorizes that this disruption can be the result of inheritance, early learning experiences, or both. In his newly published book *The Chemistry of Love* (Little, Brown), Liebowitz recounts the story of one young man, whom he describes as a classic "attraction junkie":

"He used to tell me that 'falling in love was like taking amphetamines.' On one occasion he met someone he really liked,

and the two of them spent the next five days together. What made this a little unusual was that they barely slept during that time and also never spent more than one day in the same city. They met in New York, went down to Baltimore to meet her brother and get the keys to the brother's boat, which was docked up in Newport, Rhode Island, but on the way detoured to visit someone in Boston. On the fifth day my patient was just beginning to tire out when they met a cousin of his new girlfriend. The cousin took one look at her and asked my patient: 'How long has Jane been acting like this?' He said, 'Acting like what?' To which the cousin replied: 'Not sleeping, talking all the time, making plans to sail to Georgia, that kind of thing.' My patient said: 'She's a little high, but so am I; we're in love.' At this point the cousin said, 'Jane, when did you stop your lithium?' Turns out Jane was a manic-depressive and had not taken her lithium for two weeks. '*You* may be in love,' the cousin said to my patient, 'but I think she's manic again.' "

The young man described above has a romantic disturbance that is prevalent among what Liebowitz's associate, Dr. Donald F. Klein, calls hysteroid dysphorics. As the story illustrates, the condition resembles manic-depressive psychosis except that severe mood swings are determined by whether or not the individuals are in love. These people usually have a history of forming one disastrous relationship after another. A common problem among them, the researchers observed, is that they are so desperate for the giddy thrill of new romance that they don't allow enough time to take a good look at just who they are falling for. Klein began to wonder whether their relentless pursuit of love reflected a craving for phenylethylamine—the brain's equivalent of amphetamine.

To test his colleague's hypothesis, Liebowitz placed his male patient on a monoamine oxidase (MAO) inhibitor—an unusual class of antidepressant drug that prohibits the breakdown of phenylethylamine. Within a few weeks, Liebowitz reports, the man "settled down to a more normal attraction pattern. He no longer got so carried away by romance. The frantic need to have somebody all the time seemed to vanish."

This was all the more surprising since the patient had undergone several years of psychotherapy, with little sign of improvement. "Talk therapy helped him understand himself better," Liebowitz is quick to point out, "but it appears that until the MAO inhibitor was administered, he was largely unsuccessful in applying what he had learned, because of his overriding emotional response."

Of course, a solitary patient's reaction to a drug proves little—if anything. So Liebowitz tested several dozen more patients in a carefully controlled clinical trial, which he carried out in conjunction with colleagues at Columbia University and the New York State Psychiatric Institute. The results, which will be published soon, show that the overwhelming majority of hysteroid dysphorics benefited markedly from treatment with a MAO inhibitor. By contrast, few responded to a more common class of antidepressant drug.

Liebowitz's work has recently expanded to include people who might be called attachment junkies. In direct contrast to attraction junkies, these individuals tend to single out one partner whom they then cling to with the tenacity of a barnacle. "Even if the relationship proves disastrous," says Liebowitz, "they won't loosen their grasp for fear of being overwhelmed by anxiety or depression."

Researchers have noted that the attachment junkie's response to being separated from a long-term partner closely parallels the withdrawal symptoms of a heroin addict. And in fact, animal studies now highlight dramatic similarities between social dependence and narcotic dependence.

"At a neurochemical level," reports Jaak Panksepp, a professor of psychology at Bowling Green State University, in Ohio, "attachment is essentially an addictive phenomenon involving opioids [the brain's version of opiates]." Panksepp and his colleagues have studied the distress-vocalization response of puppies, young guinea pigs, and baby chicks who are removed from their normal social environment. To discover which neurochemicals trigger separation anxiety, the researchers tried to modify the animals' responses with a variety of drugs, including stimulants, sedatives, antipsychotics, and tranquilizers. Only two types of drugs were found to suppress crying without also sedating the animals: narcotics, most notably a brain opioid called beta endorphin; and clonidine, a poorly understood drug used to reduce the severity of withdrawal symptoms in heroin addicts going "cold turkey."

"It's fairly unambiguous that brain opioids tend to inhibit activity in the crying circuit," says Panksepp. "So one might say that an animal learns attachment by the stimuli—usually contact with its mother or father—that trigger the release of opioids and thereby relieve separation stress."

> *"Human beings are the sexiest animals on Earth, virtually alone among species in their freedom to engage in sex all the time, irrespective of reproductive matters."*

Panksepp and his colleagues have also used electrical-stimulation procedures to map out the animals' distress-vocalization circuits. The crying pathway was found to be situated in a brain region dense in opioid receptors, providing further confirmation of the theory.

Since this finding has been shown to hold true across a diverse range of species, it is likely that the same neuromechanisms underlie human bonding. Extrapolating from the animal findings, Liebowitz believes a dependence on opioids is what fosters close ties between infant and mother, as well as between man and woman. He speculates that this method of pair-bonding evolved in the latter case "so that partners would stay together at least long enough to conceive and rear young." According to Liebowitz, amphetamines may bring people together, but it is opioids that keep them together.

As for his attachment junkies, Liebowitz thinks they "probably produce too few opioids, so they cling onto their mates to keep the level in their neural reservoirs from falling below the threshold mark, which would trigger a panic attack. Put another way, they are unknowingly using their partners as mood regulators."

While a dearth of opioids may foster unhealthy dependencies, too many opioids may prove even more debilitating. Not only do socially deprived animals stop crying when they are injected with opioids, they also show a reduction in gregariousness. They cease to seek out physical contact with their parents or siblings and instead engage in unusual, highly repetitive activities in isolation. These behaviors, in the opinion of Panksepp, suggest an animal model for autism.

"Autistic children are also known to engage in ritualistic activities, and while they do cry, it's never due to separation distress," explains Panksepp. "So we've been entertaining the possibility that autism is caused—at least in part—by overproduction of opioids. Our tentative hypothesis is that kids with a surplus of opioids would not bond to their mothers or feel a need for physical affection, as other children do."

The poet in us may be offended to hear researchers equate longings of the heart with an addiction. But a craving for love need not carry the same pejorative connotations as, say, a craving for heroin. Drug abuse is unhealthy, argues Liebowitz, because it induces a good feeling without having accomplished anything. By contrast, getting that fix from another human being exerts an overall beneficial influence on our lives and motivates us to engage in the very activities that are most vital for survival. "That's why love is, by definition, the strongest feeling we can have," insists Liebowitz. "Other things—stimulant drugs, passionate causes, manic states—can induce powerful changes in our brains, but none so reliably, so enduringly, or so delightfully as that 'right' other person."