In Search of Sleep

Millions of Americans are plagued by insomnia. It’s a serious public-health risk that too many doctors ignore. But new brain science offers hope that we may someday stop all that tossing and turning

By Barbara Kantrowitz

NEWSWEEK
July 15 issue — I didn’t sleep well last night, but that’s nothing new. My sleep problems began 20 years ago, just before my oldest son was born. Since then, I’ve spent far too many nights worrying about how I can’t get to sleep and how I’ll be too tired to do all the things I have to do the next day. Every morning I grab my coffee with the eagerness of an addict looking for a fix.
IT ISN’T MUCH comfort to learn that there are as many as 70 million of us problem sleepers out there, according to Dr. Carl E. Hunt, director of the National Center on Sleep Disorders Research. All across America, people are tossing and turning in their beds just like me. About half of problem sleepers have a sleep disorder, something physically wrong that keeps them from getting adequate rest. As for the others, Hunt blames too much electric light, cable TV, the Internet, e-mail and jet travel—a world that never sleeps.

That’s more than just a boon to Starbucks; it’s a major threat to public health. The average American now sleeps about seven hours a night, about 90 minutes less than people did a century ago. This means a huge sleep debt, which shows up in higher accident rates on the highway and in the workplace. Going more than a day without sleep affects performance as much as a blood alcohol level above the legal limit, according to some studies. There’s convincing evidence that untreated sleep disorders can increase the risk of high blood pressure, coronary-artery disease, heart failure and stroke. Hunt says researchers also think lack of sleep can up the odds of developing obesity and diabetes.

FINDING THE ‘SLEEP SWITCH’

With all that to worry about, now I really won’t be able to sleep. But there’s reason to hope: the more we learn about why we can’t sleep, the more light scientists can shed on how we might be able to solve our sleep problems. One of neuroscience’s most promising recent discoveries is the “sleep switch” in our brains, which gives us an even better understanding of the biological mechanisms that regulate wakefulness and sleep. Unfortunately, we’re still a long way from being able to pull that switch ourselves.
Even if we don’t have one of the many sleep disorders doctors have now recognized, other factors can keep us from the rest we need: too much caffeine, smoking, alcohol, not enough exercise, irregular hours, a new baby, noise in the bedroom, even an uncomfortable mattress.

Some of these lifestyle habits may seem so trivial that many insomniacs ignore them, not realizing that sleep problems—like any other medical issue—can be managed. Each story is individual, but mine is fairly typical. Like many insomniacs, I’ve spent years trying various remedies of my own: hot milk, lavender-scented pillows, soothing music at bedtime. Nothing has worked. So, a couple of weeks ago, I sought help from Dr. Jean Matheson, medical director of the Sleep Disorders Clinic at Beth Israel Deaconess Medical Center in Boston. Matheson, whom I’ve known for many years, arranged to have me undergo a sleep evaluation at her hospital. She didn’t promise a total cure, but she did assure me that the evaluation, which would include a night in a sleep lab, could give me a much better idea of what was going wrong. Then, maybe, we could fix it.

Although there are hundreds of sleep clinics like Matheson’s accredited by the American Academy of Sleep Medicine, primary-care physicians are often slow to refer patients who complain of sleep problems. That’s because sleep is still largely ignored in the typical medical-school curriculum. As a result, people with sleep problems are too often incorrectly diagnosed with psychiatric disorders, like depression, or dismissively told that they should take a nice, long vacation. Dr. William Dement, a pioneer in sleep research and the founder of the Stanford University Sleep Research Center, finds this ignorance particularly frustrating, since our knowledge of sleep has expanded so dramatically. “My mission, passion and total disgruntlement,” he says, “is that the public should know the things we’ve known for a quarter of a century.” Dement’s colleague at Stanford, the French-born neurologist Christian Guilleminault, recalls one of his medical professors in Paris vigorously trying to discourage him from going into the field. “Sleep,” the professor told Guilleminault, “is for dreamers.”
A RAINBOW IN A BLACK HOLE

As it turns out, the nature of dreaming is just one of many discoveries from researchers like Dement and Guilleminault. Until about 50 years ago, even most scientists considered sleep a kind of black hole defined primarily by what it was not: consciousness. But in the 1950s, they began to see shades of gray, and even glimmers of a rainbow, in that black hole. These insights were possible because of the earlier development of electroencephalography, which allows researchers to chart brain activity during the night by attaching electrodes to the head and scalp. This is still basically the same technology that sleep labs use today, with a few new refinements.

In the 1950s, Dement and colleagues described how the sleeping brain goes through repeated cycles and also showed that dreaming occurs during REM (for rapid eye movement)—the sleep state when the body is essentially paralyzed and the brain is active. In the non-REM sleep state, which itself is divided into four stages of progressively deeper sleep, the brain is relatively idle while the body may still move. People pass through these states several times during the night in a fairly standard pattern called “sleep architecture” that varies with age. But things can go wrong. For example, in REM behavior disorder, patients cross the boundaries between REM and non-REM in bizarre ways by acting out dreams while sleeping. In other words, they’re dreaming but not paralyzed. It is most common in men over 50, and often the dreams are violent, with the dreamer fighting attackers—which can be very hard on the people they share a bed with.

In more recent years, scientists have pinpointed the part of the brain that Harvard neurologist Clifford Saper and his team at Boston’s Beth Israel Deaconess call the sleep switch. This sleep-regulating center is a clump of cells in the front of the hypothalamus—often called the “brain of the brain”—that are active in sleep but not in waking. These cells connect chemically to cells in the back of the hypothalamus that are known to keep both animals and humans awake. Nerve cells at the front of the hypothalamus release chemical messengers that travel to the back and essentially shut off activity there. Last year Saper’s team proposed a model for how a similar process occurs in the reverse direction to keep us awake.

THE BODY’S ‘FORBIDDEN ZONE’

The switch doesn’t work alone. The body also responds to its own circadian rhythm, our biological clock. You need to
sleep for a certain number of hours within a cycle of approximately 24 hours in order to function. And when are you the most sleepy in this cycle? It’s not late afternoon, when I have the urge to gulp down another latte. The height of sleepiness is actually at the end of the night. “In that hour right before you wake up, your circadian drive to sleep has to be at its maximum to keep you asleep,” says Saper. The risk of accidents is higher during this circadian dip in alertness. The time of day when you feel the least need to sleep is just before your regular bedtime, Saper says. For example, if you usually fall asleep at 11, the drive to stay awake is going strong at 10—or you would fall asleep then. Saper says this last hour or so is the “forbidden zone” because your body doesn’t allow itself to sleep at that time.

This rhythm isn’t immutable. Most people regularly change it by, for example, having different bedtimes on weekends. But if you want to test the circadian rhythms yourself, think about that last half hour on Sunday night, when you’re trying to go to sleep a little earlier again to get ready for work Monday morning. Not easy, is it? Sleep doctors call messing with that forbidden zone on the weekend “Sunday insomnia.” And there is also a class of sleep disorders, some hereditary, that affect circadian rhythm. People with delayed sleep-phase syndrome (so-called night owls) may have body clocks out of sync with the 24-hour day.

So now we’ve got the sleep debt, the switch and the circadian rhythm. All these interact with emotion, stress and cognition to influence your ability to go to sleep. In other words, if you’re worried about your kids, or the mortgage or a big project at work, you have trouble sleeping. Many Americans experienced this disruption in their natural sleep patterns just after September 11. Of course, we all have trouble sleeping from time to time; it’s part of life. But when sleep problems continue for weeks and months, you need extra help.
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Emmanuel Mignot led the Stanford University research team that found the gene that causes narcolepsy in dogs like his Doberman, Prancer.

CAFFEINE AND SLEEP

And that’s how I ended up at the sleep clinic. (An overnight stay, which costs between $1,200 and $1,600, is covered by most health insurance.) A few days before my sleep study, I received a set of instructions. Most seemed fairly routine: eat a normal dinner, bring comfortable pajamas. But one admonition stopped me cold: I had to avoid caffeine after noon. As my friend, Matheson has been telling me for years that I need to cut down on caffeine, but this has not prevented me from acquiring a three-cup-a-day habit. (OK, four ... maybe five—but only on a really bad day.) Kicking caffeine, if only for a few hours, was the roughest part.

The first step was taking my “sleep history.” Matheson asked me a long series of questions: How long does it take you to fall asleep? Once asleep, do you have trouble staying asleep? Do you have any discomfort in your legs when you are lying in bed trying to sleep? Do you snore? Do you fall asleep unintentionally during the day? The questions are designed to ferret out real sleep disorders like apnea, in which a patient’s breathing is interrupted many times during the night, or restless-leg syndrome, characterized by sleep-disrupting aching or crawling sensations in the lower legs. A sleep evaluation also includes a complete medical history and a general physical examination. Matheson asked about my daily routines, habits, illnesses and whether I was taking prescription or over-the-counter medications. This kind of detailed evaluation is critical, Matheson says, but often too time-consuming for harried doctors. In many cases, the patient is having trouble sleeping because of a combination of factors—some physical, some emotional—and it can take considerable effort to uncover them and see how they influence each other.
That night, I was one of four patients in the Sleep Health Center laboratory affiliated with the hospital. I was greeted by the manager, Melissa Nappi. She expertly stuck electrodes on my head, chin and legs, and taped tubes below my nose that checked my airflow. She also strapped bands around my upper chest and abdomen that measured my efforts to breathe and a small microphone to my throat to check for snoring, often a sign of apnea. This was all connected to monitors outside the room. From there, Nappi tracked me all night.

Despite all this equipment, I had no trouble falling into what I thought was a very deep sleep. Matheson says sleep-lab patients often report that they’re more relaxed when they’re away from their own bedrooms, the scene of so many failed attempts at slumber. I remember waking up only once, around 5 a.m., and then quickly falling back to sleep. But what seemed to me like seven fairly uneventful hours actually turned out to be something very different (more about that later).

SNACKING ON SLEEP

Much of our current knowledge about sleep—and what happens when you don’t get enough of it—grows out of the kind of clinical observation I underwent that night. As the science of sleep has evolved, doctors have studied many thousands of patients in the lab—some sleeping normally, others deliberately deprived of rest. The results aren’t encouraging for those Type A’s who boast about getting by on just four or five hours a night. “Despite what they claim and believe about themselves, they are impaired,” says David Dinges, a professor of psychiatry at the University of Pennsylvania School of Medicine who studies sleep and wakefulness. “What they are doing is just sort of snacking on sleep. They want to take sleep the same way they take fast food.” But, he says, people who chronically deprive themselves of an hour or two of sleep a night ultimately are as sleep-
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deprived as someone who’s been awake for 40 hours. And that means they’re, in effect, operating as though they were under the influence. Caffeine and other stimulants only temporarily mask the symptoms.

If you need an extra incentive to stay asleep a little longer, consider the results of studies published last week by researchers at Harvard. They found that people who slept well remembered a new task they’d learned the night before better than those who didn’t. The researchers say that there was a significant correlation between improved performance and the amount of Stage 2 non-REM sleep late in the night. They also found that “power napping”—up to an hour in the middle of the day—helps stop deterioration in performance. “You work on something until your brain screams, ‘No more, no more!’ ” says Robert Stickgold, assistant professor of psychiatry at Harvard Medical School. “Then you take a little nap and you’re all better.”

Those little naps could really help people who work irregular hours. More than 20 million Americans work nights or evening shifts, and studies have shown that they are much more likely to have sleep problems. That’s bad enough if you’re, say, a night watchman, but catastrophic if you’re a bus driver, an airline pilot or, ironically, a medical resident—recent medical-school graduates who spend three to seven years training in a specialty like pediatrics or cardiology and often work more than 100 hours a week all around the clock. Just last month, the group that accredits the nation’s teaching hospitals imposed strict new limits on their hours—although the new rules will still mean grueling schedules of up to 80 hours a week with as little as 10 hours of rest between shifts.

NARCOLEPSY AND CATAPLEXY

As we get less and less sleep, scientists are learning more and more about how sleep works. These breakthroughs could point the way to a sleeping pill that more closely resembles the natural process of falling asleep. Some of the most interesting discoveries in the past few years have grown out of one of the most devastating sleep disorders: narcolepsy. Narcoleptics fall asleep uncontrollably throughout the day. Most often, symptoms appear in early adulthood, and they can destroy personal and professional lives. For years, Bob Cloud, a 58-year-old Cincinnati lawyer, would doze off in mid-sentence. He once fell asleep during an opposing attorney’s closing argument, and again sitting in front of a judge. Narcoleptics like Cloud also suffer from a bizarre condition called cataplexy, in which they
can collapse in a heap on the ground, conscious but essentially paralyzed. Cataplexy is often brought on by intense emotion, so Cloud couldn’t even play baseball with his kids. “Just the excitement of playing with them would cause the cataplexy to kick in,” says Cloud, now president of the Narcolepsy Network, a support group. But today, Cloud is able to work part time, thanks to new medication.

In 1999, after a decadelong search, a team led by Stanford University researcher Dr. Emmanuel Mignot found the gene that causes narcolepsy in dogs that carried the disorder. Mignot says he pursued this gene for so long because he thinks narcolepsy holds the key to other mysteries about sleep. The gene turned out to be a receptor for a neurotransmitter called hypocretin or orexin (it has two different names because it was discovered at two different research labs the same year and named independently by both). The receptor has a mutation in narcoleptic dogs, leaving hypocretin with nothing to bind to. Several weeks after Mignot’s team published its finding, another team at the University of Texas Southwestern Medical Center at Dallas published a study showing that if hypocretin is knocked out of mice, the result is also a condition that resembles narcolepsy.

MIRACLE PILLS?

After the discovery in dogs, Mignot and his team moved on to people. In 2000, they published another study showing that in seven of nine patients with narcolepsy, hypocretin levels were too low to detect. That meshes with Saper’s sleep-switch model: he proposes that hypocretin is the chemical in the hypothalamus most likely responsible for pushing the switch in the direction of wakefulness. Which raises another interesting possibility: the creation of a drug that keeps us awake for long periods of time. No one has come up with such a miracle pill yet, but researchers are working hard on it.

In order to succeed, they’ll have to answer the most basic question about sleep: why we need it at all. “It’s really the last remaining mystery,” says Mignot. Some researchers, like Saper, think that one possibility is that during the day the nerve cells in your brain fire away and build up messenger molecules that carry information. It’s like a blackboard that you write on, Saper says. You fill up all the free space, and then you have to write over what you’ve already written unless you find a way to erase what you don’t need anymore. “You have to let all of these signals clear and convert that information into something
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that is long-lasting,” Saper says. That’s what cells seem to do during sleep. If that theory is true, it suggests that sleep is even more vital than we imagined.

As for my own sleep study, those seven hours were surprisingly revealing. Matheson told me that I was actually aroused from sleep 90 times. Each disturbance in my sleep was preceded by a slight drop in my blood oxygen level and difficulty getting air through my nose and throat. Matheson’s preliminary diagnosis: mild sleep-disordered breathing, probably exacerbated by allergies. The solution? She recommended starting with sleeping on my side, getting a prescription nasal spray for my allergies and cutting down on caffeine. She also suggested behavior-modification therapies to help me when I worry about how I’m not falling asleep. If these don’t work, we can experiment with other things. And I’m going to do it, really, except right now, I think I’ll just ... take a quick nap.

With Claudia Kalb, Karen Springen and Mary Carmichael

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