

a much paler spirit behind, who asks only to be left alone, to sleep. You're irritable, moody, and you're closer to tears than usual. Everything seems to require much more effort.

Face it, you're miserable.

No wonder sleep deprivation, the extreme on the insomnia continuum, was used as a torture during the Spanish Inquisition.

We all spend about one-third of our life asleep; if you live to be eighty, that works out to about twenty-seven years of sleeping.

Sleep is, quite simply, a biologic necessity, a demanding human need that must be met by most of us daily, just like the need for food to eat, water to drink, and air to breathe.

Faced with this imposed biologic sentence of sleep, many have tried to shorten the time needed for rest, and their observations are important in helping us to understand this basic daily requirement.

### Randy Gardner: A Boy with a Dream

In January 1965, Randy Gardner was a seventeen-year-old San Diego high school student with a problem: he didn't have a project for his high school science fair. He wasn't interested in the usual sorts of science projects, but wanted to do something "extreme."

Randy chose for himself a most unusual science project: he decided to try to qualify for entry into the famous *Guinness Book of World Records*. The achievement he was after was in the field of endurance. The challenge was straightforward – all he had to do was stay awake.

He wanted to be able to lay claim to the longest documented time without any sleep at all, to stay awake longer than anyone else had ever done in the past. The old record in

## T H R E E

# Sleep Deprivation, Snoring and Sleep Apnea

**Y**ou're tired. Your eyes burn as if they have been rubbed with steel wool. Dim light or shade helps somewhat, but the bright sunshine of morning makes you squint and wince in pain. The dryness, the grittiness, are unrelenting; your poor eyes are so tired that they cannot even produce enough tears for their own comfort. It's very difficult to keep your eyes open, and when they do close, even for a brief wink of time, the soothing relief is immediate.

The rest of your body is unhappy as well. Your head throbs its displeasure – not an acute stabbing pain but a steady, wearying, punishing ache. You feel cold, perhaps nauseated, and certainly weak. It's an effort to move, and only a conscious act of will overcomes the inertia.

Mentally you're no longer the happy-go-lucky person you are when well rested. Your zest for life has vanished, leaving

### Can We Learn to Sleep Less?

"Sleep," said Thomas Edison, "is a colossal waste of time."

Experiments have been done with volunteers who tried to reduce their sleep from the usual seven and a half hours to five and a half hours by decreasing their sleep by thirty minutes every two weeks. Most of the volunteers had little trouble reducing sleep by a half-hour, or even an hour, but they began to notice some difficulty when sleep was reduced by more than this. They were able to awaken on time, and they were able to function at work and in their social obligations, but they found themselves simply more fatigued. The sleep reduction didn't seem to pose a threat to anyone's health, and the extra time was useful for studying, exercising, or watching television. However, many of them just "didn't feel as well." They found themselves to be more irritable, more pessimistic, and less fun to be with, though often their co-workers and peers did not notice much of a change.

All the volunteers had difficulty in reducing their sleep beyond five and a half hours a night. This may be a biological limit for most adults. Most of the volunteers increased the amount of sleep they obtained when the study was over.

For most adults, reduction in the amount of sleep is possible, but fatigue and changes in mood make it undesirable. It is estimated that about half of the adult North American population is already sleep deprived (that is, receiving less than the ideal amount of sleep), and any further reduction would have marked changes on mood, vigilance, and performance.

the book was 260 hours of continuous wakefulness. He was going to try to beat it. To make his mark, Randy would simply have to stay awake for eleven days, with no rest at all, no naps, no breaks.

Randy found that the first couple of days (and nights) weren't too difficult at all. He enlisted the help of a couple of friends, who kept him awake at night by walking, playing games or doing other exercise, talking, or even by goading him to take cold showers. Randy vowed to use no kind of stimulant throughout the science project, not even coffee. The first night was easy. By the end of the second day, though, he did feel quite tired; he had trouble focusing his eyes and couldn't read. Soon afterward he was unable to watch tele-

vision – the images were too blurred – and that symptom remained for the rest of the experiment. His eyelids became so heavy that he spent the rest of the time tilting his head back to see.

By the third day, his mood was definitely different – he was irritable and wanted to be left alone. He had trouble with coordination, and there was some slurring of his speech.

On the fourth day, he became more than irritable – he became uncooperative. He began to have lapses of memory, which would occur more and more frequently as time went on. He complained of seeing "fog" around streetlamps, and believed that someone's tweed suit was made of worms. The prolonged sleeplessness was obviously taking its toll, but he would not give in and close his eyes to sleep.

By the end of five days, Randy's parents were worried that the prolonged lack of sleep might cause him some psychological harm – that he might become mentally ill, truly insane – from lack of sleep. They had some cause for concern.

Six years earlier, in New York City, a disc jockey named Peter Tripp had, in fact, become mentally ill after attempting a similar stretch of sleeplessness. Tripp's continuous sleeplessness was a publicity stunt, to raise money for the March of Dimes. He broadcast a daily program from Times Square, and crowds gathered to watch him in his glass booth. Tripp was able to stay awake for two hundred continuous hours (about nine days), but in the last few nights of his sleeplessness he became paranoid and his behavior resulted in the marathon being stopped. It appeared that lack of sleep had made him insane, at least temporarily.

Randy's experience was generally much better than the radio announcer's. Despite a few hallucinations, he never manifested serious symptoms of psychiatric disorder, and was always in touch with reality.

By the end of nine full days of sleeplessness, however, major effects of sleep loss began to be noticeable in Randy. He could no longer speak in full sentences, but used only fragmented collections of phrases. He had frequent memory lapses and difficulty following conversations. It appeared that he was paying attention only part of the time and had an obvious inability to concentrate. Nevertheless, he was still determined to succeed.

On the last evening, even though his vision was very poor and he often saw double, he chose to try to stay awake by spending part of the time at an all-night penny arcade, playing a basketball game. Randy played against his attendant for the evening, the renowned sleep researcher Dr. William Dement, and though he had been awake continuously for almost 250 hours and Dr. Dement had had regular sleep, Randy won every one of the hundred games they played!

The next day, Randy did indeed break the old record, with a new figure of 264 hours of continuous wakefulness, eleven full days and nights without sleep.

When he went to bed later that day, after his stint of 264 hours of wakefulness, researchers had no idea how long he might sleep to make up for the hours of rest that he had missed. Surprisingly, he slept only fourteen hours and forty minutes that night, and the following night only eight hours. Within several nights, he was back to his usual pattern of sleeping – about seven to seven and a half hours a night. He never made up the eleven nights' sleep he had lost.

Throughout the whole ordeal, Randy demonstrated no marked abnormal psychological or physical symptoms, except for a few mild hallucinations. He suffered no lasting emotional or physical damage, and after several nights' normal rest, appeared to have recovered completely.

## The Mental and Physical Effects of Sleep Deprivation

Most of us don't try to stay awake for eleven days straight as Randy did. What happens is not that we avoid sleeping altogether, but rather that we accumulate a sleep debt and try to function on less than the optimal amount.

Say you need seven and a half hours of sleep a night to feel alert on awakening and not excessively sleepy during the day, but that work pressures or other factors such as illness or anxiety prevent you from getting more than six hours a night. At the end of a week you have a full night's sleep debt. How does this affect you? Usually, you are not hallucinating, not seeing fog around lampposts or imagining that tweed jackets are woven out of worms – in fact, you are unlikely to experience any of the dramatic effects of complete sleep loss. However, you are not quite the same as you would have been had you slept as long as you needed. This is the common type of sleep deprivation, and the one we have all experienced.

Mood is one of the first casualties of sleep loss. In general, when you have been deprived of sleep, your emotional reserve is markedly diminished, making you less adaptable. Events seem to take more of a toll on your feelings than they would if you were well rested. You are much more likely to feel saddened, depressed, and forlorn. Fatigue and hopelessness are all-pervasive.

Feelings of persecution, of mild paranoia, often develop after seventy-two hours or more of sleep loss. However, only in 2 to 3 percent of cases do gross psychiatric changes (such as those experienced by Peter Tripp) appear, even after prolonged sleep loss.

Motivation often diminishes quickly from sleep loss. Though there is very little measurable difference in dexterity

or manual performance, the willingness to attend to even simple tasks wanes. If you are tested on mathematical skills or chess moves, sleep loss doesn't seem to make much difference. What is different, though, is that you're simply not interested in doing the math or playing chess; you'd rather rest. Studies of sleep loss among soldiers in the Israeli Army produced interesting results. A cardinal rule for these soldiers is to fill up their canteens with water at every opportunity. It's a basic rule for surviving the climate in the Middle East. After maneuvers involving some sleep loss, Israeli soldiers were able to shoot just as accurately and perform other military tasks just as well, but the essential principle of replacing water reserves was simply forgotten, as though the motivation for survival had vanished. The same phenomenon is observable among overtired interns; they are able to keep up with often complicated drug regimens but sometimes will skip that extra walk down the corridor and around the wards to check on their patients.

Tasks that involve forethought, planning, and anticipation are the ones that suffer when you are deprived of sleep. It's as if your perspective changes, and you lose the grasp of the relative importance of actions. Your ability to reason and think remains relatively unaffected, but your desire, your will, is diminished.

Higher neurological functions are impaired by sleep loss as well. The first observable change is usually a decrease in your awareness of your environment, and your perception of differences slows. This change has grave consequences for those employed as professional truck drivers or power-plant supervisors who monitor computer screens, for in these situations extreme vigilance must be exercised while doing fairly boring, repetitive tasks.

When you are deprived of sleep, your eyes don't work as

well, and difficulties with vision are very common. The first changes are usually minor: some blurring of vision when reading, or some errors in judging distance or depth. You may reach for a coffee cup and miss because your eyes told you it was closer. As the period without sleep lengthens, other visual errors become more common. Though a significant number of normal people who undergo prolonged periods of wakefulness have hallucinations, it usually takes a prolonged sleep loss – at least seventy-two hours – to bring these on. During sleep loss of shorter duration, visual errors, mistakes in vision, are much more common. Perhaps you “saw” the doorknob on the left rather than the right, or misread the hands on the clock. These errors don't happen if you focus your mind specifically on the doorknob, for example, but if you are looking at something else and glimpse the door out of the corner of your eye, your perception of the knob's location may very well be wrong if you are very sleepy. These errors are easily corrected, and often comical, but they do show that the visual system, one of the most important for information gathering, is not working well. Similarly, it's quite common to have some difficulty with coordination, and mild hand tremor or difficulty with fine motor skills (such as threading a needle) often occurs.

One of the most consistent findings in studies of prolonged sleep loss is impairment of memory, especially memory of recent events. Somehow the system of committing information to memory, which is a very complicated process, does not work at all well when we have lost sleep. For this reason, it is more difficult to learn new information when you are sleep deprived. The system whereby your brain assimilates knowledge and then keeps it available for retrieval (that's really all memory is) just doesn't function nearly as well when you are not well rested.

### Sleep After Sex

Most people, both male and female, are aware of an increased tendency toward sleep after sexual orgasm. The feeling of muscular relaxation, the intimacy, and the calm or peace that is often present after orgasm – all contribute to encourage the onset of sleep.

However, sexual activity that does not lead to orgasm may very well make sleep nearly impossible. The heightened sensory awareness, feelings of frustration or anger, and interpersonal conflicts that often result when only one partner reaches orgasm contribute to a delay in the arrival of sleep, and in fact make sleep, when it does come, lighter and interrupted by frequent awakenings. It seems clear, then, that sexual intercourse itself is not the cause for increased sleepiness, but orgasm. Some sexual activity that does not lead directly to orgasm may be very relaxing – for example, massage, stroking, light touch, or simple physical closeness such as hugging. These activities, which reinforce interpersonal bonds and communicate emotions between people, allow us to relax, and to let sleep occur.

### Everything Hurts When You Don't Sleep

Physically – apart from being sleepy of course, – several changes occur when you are deprived of sleep. There is no doubt that you are more sensitive to pain. Many so-called chronic pain syndromes, such as fibromyalgia, are associated with daily sleep loss, and this poor quality of sleep is felt to be part of the cause of the pain; sensitivity to pain is known to be heightened even after short periods of sleep loss. Consider the following experiment. Volunteers were exposed to several painful stimuli and asked to grade them in severity. For example, a blood pressure cuff was inflated on the arm and the volunteer had to say whether it was mildly uncomfortable, extremely uncomfortable, or unbearable at a particular pressure. After several nights of relatively minor sleep deprivation, almost all the volunteers felt pain at a lower pressure of the cuff compressing their arm. Pain is, of course, a purely subjective feeling, but there is evidence to suggest that you feel pain much more easily when you're tired. This is important news for anyone who has chronic pain.

Increased appetite is a common symptom of sleep deprivation, though the mechanism is not understood. Could it be that chronic sleep loss contributes to the epidemic of obesity? It certainly is possible that one is related to the other.

In a similar vein, increased sexual drive is often a symptom of sleep loss. This is surprising, because most physical stresses cause a decrease in sexual drive, a reduction that makes sense from an evolutionary point of view; the process of mating is threatened by any physical force that would decrease one's ability to care for offspring. Nevertheless, chronic sleep loss can produce increased libido.

### Microsleeps: Here One Minute, Gone the Next

How does your mind cope with enforced sleep loss? If you insist that it must stay awake, what does it do?

With significant sleep deprivation, your brain recognizes that it needs some rest, and in spite of whatever else you're trying to do, sleep will occur, but only for a few seconds at a time. These short bursts of sleep, documented on EEGs, are called "microsleeps"; they're universal among those who have experienced prolonged sleep deprivation. These microsleeps are forced on you; you don't ask for them, but they intrude onto your wakefulness anyway, barging in and taking control of your mind for a second or two at a time. They consist mainly of Stage I (light or twilight-zone) sleep, and thus they allow your brain some rest even when you are not in bed. Of course, even though you're not wide awake for the several seconds of microsleep, you don't lose muscle control and fall down; nevertheless, your mind is not aware of the external environment for those few seconds – remember, that's the definition of sleep. After a short pause in brain functioning, your brain works normally again, and you are wide awake and fully responsive. This lapse means that, if someone had been speaking to you, you would have missed a word or two. If you were

### Sleep Less, Live Less

The amount you sleep does affect your chances of living longer. Over a period of six years, the American Cancer Society studied one million Americans in San Francisco. Their survival was rated against many lifestyle factors, including sleep patterns. Surprisingly, men who slept four hours a night or less had mortality rates ten times greater than that of those who slept between seven and eight hours! Importantly, those men who overslept, who slept longer than ten hours a night, had double the mortality of those who slept for only seven to eight hours. It seemed that any deviation from the usual sleep requirement for adults of six to eight hours was accompanied by a significant increased risk of mortality. Death from coronary artery disease and strokes was especially prominent in oversleepers. In fact, the National Center for Health Service Research in the United States considers adequate sleep one of the six most important factors affecting illness and death rates; the other lifestyle factors include regular exercise, not smoking, limited consumption of alcohol, regular meal schedules, and maintenance of proper weight.

formly fatal for these animals. In the experiment, he had electrodes implanted in the brains of two rats so he could identify, by EEG, when the rats were sleeping. Then the animals were placed in a Plexiglas cylinder with a clear partition separating them; they were visible to each other and to the experimenter. The bottom of the cage consisted of a circular floor attached to a motor that rotated it. Both rats had access to water and food.

While the control rat was allowed to sleep as much as he liked, whenever the experimental rat tried to sleep, the motor would come on, and the base of the cage would turn. Because the rat had to walk (to keep from banging into the side of the cage) as the floor beneath it rotated, the animal was effectively prohibited from obtaining any sleep whatsoever. He was stuck in a real rat race.

No startling differences were noted at first, but after about two weeks, the sleepless rat's paws became ulcerated and they would not heal. The rat who was kept awake soon began to lose weight, even though it had actually eaten more than had the well-rested rat. This weight loss was marked, and was felt to be attributable to the loss of metabolic control (from sleep loss), because both rats exercised the same amount and both had lots of food. The sleepless rat appeared scrawny and disheveled, and eventually, before the rat died at four weeks of sleeplessness, the animal was extremely wasted – just skin and bones. An autopsy showed only nonspecific changes in the animal's brain and tissues, much like those of malnutrition, but it was concluded that prolonged wakefulness was the cause of death.

### Can Sleep Deprivation Cause Death in Humans?

Will human beings die if they are kept awake for long enough? Obviously, no one knows for sure, as no humans have vol-

involved in a boring, repetitive task (say, adding up figures on an adding machine), you might “forget” to add one or two figures, or momentarily lose your place in the column. What's more, you would not be aware that this was going on. If the task at hand needed all your concentration, microsleeps would not occur, but when performing low-stimulus, tedious, repetitive tasks, the brain readily allows microsleeps, and without your being aware of it you are here one minute and gone the next. The significance of this to jobs that require alertness is obvious – it can be disastrous!

### The Rat Race

Is it possible to go without sleep completely? Probably not. We do know that experimental animals who are not allowed to sleep at all will eventually die, though we are not exactly sure why. This evidence comes from an experiment with laboratory rats done by sleep researcher Alan Rechtschaffen in Chicago in 1983. He showed that sleep deprivation was uni-

unteered to live in a small Plexiglas container with a rotating floor. Many sleep researchers believe that the answer is probably yes, but they agree that it would take a relatively long time, probably weeks, for death to result through this stress alone. Nevertheless, sleep deprivation produces mental and physical changes that are significant threats to health.

### Snoring

John was certainly accustomed to being the butt of jokes about his loud snoring; he had endured the kidding and the complaining all his life. Though he himself never heard it, he was well aware of this fault, and grew to be self-conscious and ashamed, even though it was beyond his control. At university, his roommate had to wear earplugs to sleep, and when he imitated John's nighttime snorting and loud whistling to the other students, they laughed uproariously. John laughed too, though he felt humiliated and powerless.

But now, things were different, and the joking was over. John's wife, who was used to his snoring, had noticed changes in her husband that worried her. She was afraid that he might be having some sort of seizure at night, or perhaps – and this was her worst fear – he had developed a brain tumor. How else could she explain his deterioration?

The first change she had noticed was in the snoring itself. Over several months, instead of the regular deep, rattling sound she had grown accustomed to from him, his snoring had developed a more ominous pattern. The regular reverberant, predictable snore would be interrupted by agonizing periods of silence when he wouldn't breathe at all. The change frightened her, and she would often sit up in bed and look over at him. He would be resting comfortably at first, but as the period of silence lengthened, he would begin to move his mouth to try to take a breath, but couldn't seem to take air in. Sometimes he would shake his head or move his hands,

even sit up in bed; he seemed to become more and more agitated the longer the period of silence. Suddenly, with a loud snort and rushing of air, he would be able to breathe again, and would do so several times in a gasping manner. Then he would settle down again, and begin the slow usual snoring. The process would repeat itself again and again.

There were other changes as well. He had recently been diagnosed as having high blood pressure and had been told to lose weight. Though he was only in his early fifties, he had also become impotent, being unable to maintain an erection to ejaculation. He told her he thought the problem was due to "stress," but she wasn't so sure.

Perhaps because of all these things, his personality had also changed; she noted that he had become more irritable, less interested in life in general. He had lost some of his *joie de vivre*. His impotence had been a direct blow to his self-confidence, and he was even more ashamed of this problem than he had been about his snoring.

One weekend morning, soon after awakening, he had gone out to get the newspaper and then completely forgotten he had done it. It seemed like such a simple error at the time, but when his wife kidded him about it, he became quite agitated. He was adamant that someone else must have placed the newspaper on the kitchen table. In the interest of keeping the peace, she backed down and let the incident pass, but she made a doctor's appointment for him. She simply had to know if her worst fears were justified.

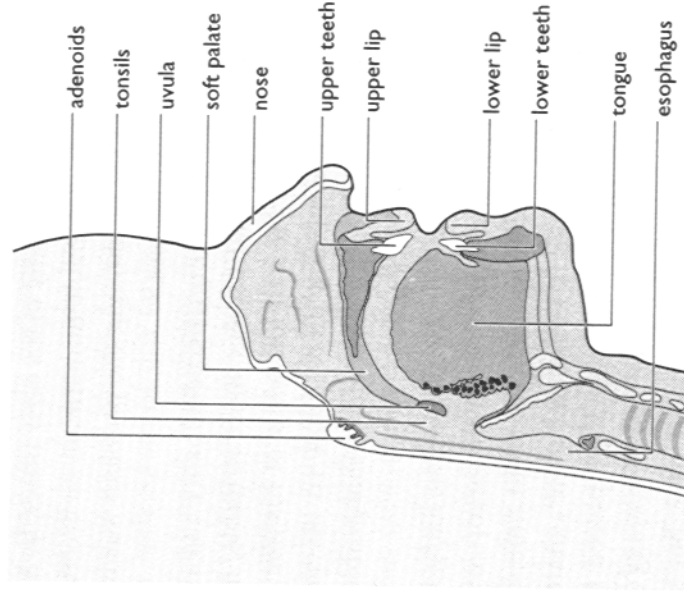
### Snoring: No Laughing Matter

"Snoring" is the term used to describe the sound of obstructed breathing during sleep. Though the noise itself may be comical, snoring is no joke, and can in fact be a serious medical problem.

The rattling noise of snoring is caused by vibration of the soft parts of the upper airway. In simple terms, the mouth and

throat consist of a bony shell (the vertebrae of the neck, the base of the skull, and the upper and lower jaws), covered on the inside with soft tissues (the muscle of the tongue, and the mucous membrane and muscles that line the back of the mouth and the throat). The hard bony shell of this anatomical region does not change in sleep, but the soft tissues do.

### The Anatomy of Snoring



During sleep, the circular muscles at the back of the mouth and the throat relax, and this relaxation allows these soft tissues to be so flaccid that they can vibrate when air passes them. The vibration of these loose soft tissues causes the snoring sound, with its characteristic rumble. There are several different soft-tissue structures that can vibrate in sleep. The tongue, simply a large thick mass of muscle, is attached to the floor of the mouth and the front part of the pharynx. During

sleep, when the muscles in this area relax (as is common in deep sleep), the tongue, because of its weight, may passively fall toward the back of the throat. This is more likely to happen if you are lying flat on your back. The movement of the tongue backward may narrow the airway. Structures at the top of the mouth can also contribute to snoring. Toward the front of the mouth, the roof consists of hard bone – the bony palate – covered with mucous membrane. However, the back third of the roof of the mouth consists only of muscle – the soft (that is, with no bone beneath it) palate. If you open your mouth and look in a mirror, you will see at the back of the roof of your mouth a fold of tissue hanging down in the midline. This is called the uvula, from the Latin *uvula*, meaning grape, because early anatomists thought it resembled a small grape hanging down from the soft palate. The uvula functions to direct food away from the space behind the nose and down to the esophagus below. However, during sleep, this whole area of the muscles of the soft palate, including the grape-like uvula, becomes quite relaxed and sags, obstructing the flow of air. On either side of the uvula lie the tonsils, and below this the pharynx itself, which consists of circular muscle, much like that in the soft palate. All these tissues can relax during deep sleep, and this relaxation, this sagging, has the effect of narrowing the opening through which air must pass. Anything that causes the airway to narrow can cause the sound of noisy, obstructed breathing. In sleep, breathing is regulated through brain centers that initiate respiration by sending a stimulus to the muscle of the diaphragm. This stimulus causes the diaphragm to begin to move; this is the first mechanical step involved in moving air into the chest. As the diaphragm begins to move down, it creates a negative pressure within the lungs themselves, as occurs in opening a bellows. This creation of the negative pressure inside the chest cavity causes



Mark Hubbard, who lives in Richmond, British Columbia, holds the record for the loudest snore ever measured. His snore in a sleep lab measured an impressive 90 decibels. A decibel is a measure of intensity of sound, and to understand how loud Mark's snoring is, consider that normal human speech is usually in the range of 40 decibels, and that city traffic is usually about 60 to 70 decibels. A jet airplane with afterburners registers about 110 decibels, and a jackhammer about 120. Each night Mark breaks the Richmond, B.C., traffic bylaw, which restricts traffic sounds to less than 80 decibels. We know from studies in heavy industries that regular exposure to noise above 65 decibels in the workplace can produce hearing loss; earplugs must be worn to prevent damage to hearing. In fact, for habitual snorers of Mark's prowess, hearing loss is fairly common. Anthony Burgess said, "Laugh and the world laughs with you; snore and you sleep alone." He may have had Mark in mind!

air to flow from outside the body through the tubing of the airways, and into the lungs. It's important to understand that this occurs because the movement of the diaphragm, and to a lesser extent the chest wall itself, has created a pressure difference between the air on the outside of the body and the air inside the chest. If there is any obstruction to this air flow (such as that mentioned above), then, as the air does move, it causes vibration of these tissues, and the resulting sound we know as snoring.

In general, about 20 percent of the adult population snore regularly, with men snoring more than women, and older people snoring more than young people. At age thirty-five, only 20 percent of men and 5 percent of women snore. By age sixty though, a full 60 percent of men and almost 40 percent of women snore. Snoring is three times more common in people who are overweight than in thin people, and is rated as a serious problem in almost one-third of marriages.

#### *Why Do We Snore?*

Snoring occurs most often in deep sleep, but it may be present in rapid-eye-movement sleep as well. Anything that causes

narrowing of the tubing of the upper airway, or excessive laxity of the tissues that line the airway, causes the air moving past to vibrate, and this vibration of the moving air produces the sound we recognize as snoring. Common causes for snoring include the following:

1. Anything that decreases the tone in the muscles of the upper airway will cause these muscles to be softer, less rigid, and more easily able to vibrate in the moving air. Alcohol is a common offender here, but so are antihistamines, sleeping pills, and many other medicines or chemicals that have a sedative or relaxing effect on these tissues.
2. Anything that causes narrowing of the airway anatomically will cause turbulence of the air flowing by, resulting in snoring. In the nose (for in sleep, air is moved through both the mouth and the nose), anatomical obstruction such as nasal polyps, old injuries, and old fractures means that the diameter of the tubing through which the air moves is both smaller and irregular. Similarly, swelling of the mucous membranes of the nose (such as might result from allergy or congestion due to a cold) also causes narrowing of the tubing. In the mouth, a large tongue, a short thick neck, or even a receding chin can result in a narrowing of the airway when the muscle support for the tongue is relaxed during deep sleep. On the roof of the mouth, an excessively long soft palate or a larger-than-normal uvula causes snoring.
3. Obesity causes narrowing of the airway because fat deposits that occur below the mucous membrane of the back of the pharynx produce effective narrowing as well. Hypothyroidism (underactive thyroid) causes the same sort of thickening below this mucous-membrane layer, with the same tendency toward snoring.
4. Any reason for increased amounts of deep sleep will cause

increased time for snoring. If you are overtired, chances are you will spend more of the night in deep sleep and, as a result, your chances of snoring are greater.

5. In children, snoring is almost always caused by obstruction to air flow because of enlargement of the tissues of the upper airway. Nasal congestion resulting from allergies or infections (such as colds) is a common cause of snoring. Because the upper airway in children is much smaller than it is in adults, a small amount of congestion or secretion can cause significant snoring. At the back of the throat, snoring is commonly caused by adenoid or tonsil enlargement in children.

#### *Tips for Snorers*

1. Lose weight. Striking changes can sometimes be seen in the snoring pattern with the loss of only a few pounds or kilograms.
2. Decrease or stop intake of alcohol, antihistamines, sleeping pills, or any other drugs that may be contributing to the problem. All these medicines can cause relaxation of the muscles, and some (namely, alcohol) can cause actual swelling of the tissues. These chemicals can be dangerous; they can convert simple snoring into sleep apnea, with all its problems. Ask your doctor whether any of your prescription medicines may be contributing to the snoring problem.
3. Sleep regularly, and sleep long enough to decrease the amount of deep sleep. The more tired you are, the more deep sleep you will have. Sleep deprivation itself predisposes one to snoring. Regular sleep habits, and adequate time for sleep every night, will help to prevent this tendency.
4. Sleep on your side. Lying on your back narrows the airway more than does lying on your side. Some people pin

clothes pegs to the back of their pajamas, or sew a tennis ball to their pyjamas between the shoulder blades, to make it more comfortable to sleep on their side.

5. Humidify the air that you breathe at night. Dry air causes irritation in the nose and airways and can cause obstruction.
6. Stop smoking and exposing yourself to irritants. Chronic swelling of the mucous membranes from smoking can cause snoring.
7. Raise the head of the bed. This simple maneuver often helps to open the airway. A brick placed underneath the legs at the head of the bed is all you need.
8. Anyone who snores significantly should see a doctor for an ear, nose, and throat examination (to rule out anatomical or inflammatory causes for narrowing) and for a blood-pressure measurement.
9. Allergies can be the cause of swelling in the nose and throat – either acute or chronic. If you suspect allergy may be a contributing factor, see your doctor.
10. Chronic snoring in children merits medical attention. It can cause decreased performance at school, irritability, inability to concentrate, and personality change, all reflections of excessive daytime fatigue.
11. More than three hundred patents have been registered for simple antisnoring devices. Some of the most successful of these are orthodontic-type devices that hold the airway open. These may be helpful to some people, especially milder cases; are usually inexpensive; and have no side effects or complications.
12. Surgical treatment for snoring should be a last resort, and usually involves removing the uvula, some of the tissues of the soft palate, and even some of the muscle on the side wall of the pharynx. This can be done by an ear, nose, and throat surgeon, using traditional surgical techniques to

ments if your bedmate's snoring is bad enough to interfere with your own sleep. Snorers are embarrassed and ashamed about the problem and would rather avoid the issue than face it directly. Snoring is not a personality fault, but it is a problem that you both share. Your insistence on focusing on the problem might very well prevent significant medical complications.

4. As you yourself progress from twilight zone into the deeper layers of sleep, your awareness of the environment decreases. If your sleeping partner's snores disturb you, try to fall asleep first – even if this means going to bed earlier. Some sort of earplug or noise protection is quite appropriate. Many couples who are used to sleeping together find that they don't sleep as well when they sleep alone. However, if your sleeping partner is unable to control snoring to your satisfaction, sleeping in a separate bedroom, even occasionally, may very well relieve some of the chronic fatigue and irritability caused by your sleep deprivation.

## Sleep Apnea

Sleep apnea is not simply a different kind of snoring. Apnea comes from the Greek word *apnoia*, meaning without breath, and is the term used to describe repetitive episodes of inability to breathe during sleep. There are two types: obstructive sleep apnea (caused by an obstruction in the upper airway) and central sleep apnea (caused by the brain's failure to initiate respiration during sleep).

Studies in a sleep laboratory proved that John, like up to 4 percent of the adult population, suffered from obstructive sleep apnea. His episodes of loud snoring, alternating with periods of little or no air flow, were typical. When he was in twilight-zone sleep, he was able to overcome the obstruction

trim away these tissues or using laser surgery. These surgeries are particularly helpful for those people who have a large redundant uvula or a large soft palate. The success rate in curing snoring approaches 80 percent. Like all surgeries, both types involve some complications and are not appropriate for everyone. Consult your doctor.

13. If you suspect that you may have sleep apnea, and not simple snoring, it is important that you have an adequate medical assessment, preferably a sleep study.

### *Tips for Those Who Sleep with Snorers*

1. Snorers are usually unaware of their behavior at night and the sounds that they produce. Because they are asleep (even though it may be only twilight-zone sleep), they cannot hear themselves, so they depend upon you to differentiate mild snoring from obstructive sleep apnea. Sometimes a tape recording is of value. Remember that at least half of the referrals for obstructive sleep apnea come from sleep partners. Don't be afraid to initiate evaluation if the snoring is significant, or if there is some evidence of sleep apnea.
2. Understanding the mechanisms for snoring often leads to lifestyle changes that may help control the problem. Losing weight, stopping alcohol intake and smoking, establishing a regular sleep pattern – all are methods to decrease snoring and in general to promote a healthier lifestyle in your sleeping partner. Insist on these changes.
3. You are entitled to a good night's sleep as well. Normal reactions to having to sleep with someone who snores include such emotions as anger, guilt, disappointment, loneliness, and frustration. Chronic fatigue and sleep deprivation are also common. It is not unreasonable to suggest that changes be made in your sleeping arrange-

to air flow in his upper airway. This milder obstruction produced his regular snoring, which measured 42 decibels. However, as he entered deep sleep, the muscles and tissues in his upper airway became more relaxed. The tissues sagged, the soft palate and uvula lost their tone, and the jaw muscles relaxed, allowing his tongue to droop backward. All these effects caused narrowing of his airway and, as he became more relaxed, eventually the airway closed off completely. When this happened, the respiratory center in John's brain sent out the signal to his diaphragm to begin the next respiration. The diaphragm contracted, and he began to create a negative pressure within his chest cavity, but it was not enough to overcome the obstruction in his throat. No air moved into his chest. He was, in fact, apneic – that is, breathless. Soon, the level of oxygen in his bloodstream began to fall, and his brain began to panic. His heart rate began to rise, as did his blood pressure, sometimes to alarming levels. Eventually his brain would initiate some changes in posture as a nonspecific reaction to the low levels of oxygen. John would move around in bed, perhaps shaking his head or flailing his arms. Eventually, his brain would wake him up to breathe. After being awakened this way, he would enter a lighter stage of sleep, the muscles in his upper airway would regain some of their tone, and he would be able to move air into his chest. The apneic spell was over. In the sleep lab, these episodes happened to John about three hundred times a night! Basically, when he slept well (that is, when he was in deep sleep), he couldn't breathe. He had a choice: he could either breathe or sleep, but not both together. Only a few seconds after waking up to breathe, he would try to go to sleep again, and the process would repeat itself. No wonder excessive daytime sleepiness is the usual complaint of patients with sleep apnea. Most patients, like John, are unaware of the roller-coaster ride

between sleep and wakefulness that they take every single night. Though they may have been in bed and thinking they were asleep for some eight to ten hours, many of them actually sleep only a few minutes each night. Some sleep apneic patients complain of insomnia; they are simply unable to get back to sleep after the frequent awakenings. Most sleep apneic patients seek medical advice because of the observations and complaints of those who sleep with them. Sleep apnea is usually preceded by several years of snoring, and is uncommon in premenopausal women. The repeated changes in heart rate and blood pressure often lead to chronic hypertension; in fact, if you are a man and you snore, your chance of having high blood pressure doubles. Because the oxygen level in the blood falls regularly during the apneic spell, irregular heart rates are very common and can be disastrous. Mark Twain wrote, "Don't go to sleep – so many people die there." He may have been thinking of sleep apnea, because the drop in oxygen in the blood, the high blood pressure, and the irregular heart beat are thought to be a common cause of sudden death in sleep.

Irritability and Depression, caused by chronic sleep deprivation, is commonly seen in sleep apnea. Because people with sleep apnea enter deep sleep for only a few minutes, they essentially live lives of prolonged sleep deprivation. Automatic behavior, like John's, especially soon after awakening, is also common; it simply reflects the chronic, unrefreshing sleep pattern. Impotency, and even incontinence of urine, are also common, as is the reflux of acid from stomach into the back of the esophagus. This acid is literally sucked up into the chest by the action of the diaphragm creating a negative pressure to try to move air in against the closed upper airway. Sweating at night occurs in almost two-thirds of cases of sleep apnea, and morning headaches are almost universal. Because

oxygen level and take steps to remedy it, the consequences could be disastrous. Avoid these medicines – they can be fatal.

4. The specific treatment for obstructive sleep apnea is usually a mask worn at night to keep the airway open. The mask treatment is prescribed by a sleep physician, and the mask is attached to the face by straps and then connected to an air pump. It's an ingenious and effective way of treating sleep apnea. Here's how it works. The main difficulty in obstructive sleep apnea, as we have seen, is that the tissues of the upper airway tend to collapse and narrow the airway. The mask treatment prevents this collapse because room air is pumped under pressure into the upper airway through the mask, causing these tissues to remain open. Usually only a small amount of pressure is needed to prevent the tissues collapsing and to stop the obstruction. By having this continuous pressure in the mouth, nose, and back of the pharynx, the airway remains open and there is no resistance to air flow when the diaphragm begins its next movement. Patients wear the mask attached to a small pump every night when they sleep. Though it sounds cumbersome, most patients are usually overjoyed with their ability to enter deep sleep again, and to eliminate the chronic sleep deprivation that they have known for years.

people with sleep apnea are sleep deprived much of the time, they fall asleep very easily – watching TV, during lectures, or any time stimulation is minimal.

The rarer form of sleep apnea, called “central sleep apnea,” occurs when the brain fails to initiate and coordinate the movements of muscles necessary for respiration. This unusual medical problem has been called “Ondine’s curse,” after a maiden in a German legend who punished her former lover by causing him to forget to breathe unless he consciously willed it. The poor man had to actively remember to initiate every single breath for the rest of his life. In contrast to obstructive sleep apnea, which is far more common, central sleep apnea does not have the snorting, gurgling respiration that signifies the closure of the airway.

#### *Tips for Treatment of Sleep Apnea*

1. Sleep apnea needs to be diagnosed in the sleep laboratory. Occasional episodes of apnea are quite common, and not enough to make the diagnosis. Sleep apnea is a significant sleep disorder, and those who are diagnosed with it are observed to have more than five to ten sleep-apnea episodes an hour, each lasting longer than twenty seconds. This syndrome puts you at risk for other diseases such as hypertension, heart disease, and stroke, and needs to be treated by a physician.
2. All the tips to prevent snoring are applicable to sleep-apneic patients (see pages 74 – 75).
3. If you have sleep apnea, do not take sleep medicines or sedatives. These chemicals will increase the relaxation in the tissues of the upper airway and make the obstruction worse. In addition, they may very well make your brain less responsive to the low levels of oxygen that the obstruction produces. If your brain does not recognize the falling