



**CONTEMPORARY ISSUES  
IN PULMONARY DISEASE**

# **Breathing Disorders of Sleep**

**Edited by**

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Teodoro V. Santiago, M.D.**

**CHURCHILL LIVINGSTONE**

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BREATHING  
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# CONTEMPORARY ISSUES in PULMONARY DISEASE VOLUME 5

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# Preface

He sleeps well who knows not that he sleeps ill.

—Old Latin Proverb

A great source of awe and delight to physiologists and physicians is the continual emergence of new fields of inquiry, often involving the discovery of “new” diseases. Discoveries are most exciting when the uncovered discipline or disorder has been right under our noses—obvious, but ignored because of that wonderful human potential to disregard what we are unable to understand or study.

Such is the case with breathing during sleep. Sleep, with its attendant phenomenon of dreaming, has been a source of wonder to man since the beginning of recorded time. Nevertheless, scientific study of sleep is recent and still embryonic. The discovery of breathing abnormalities during sleep, and the subsequent study of the underlying physiology, is even more recent. The results, however, have been nothing short of explosive. A newly recognized syndrome, obstructive sleep apnea, has been shown to be serious, associated with a high degree of morbidity, and perhaps, mortality. It is common—by some estimates approaching asthma in its incidence. Less typical or milder versions of the syndrome may explain everyday perplexing phenomena, such as hypersomnolence in the elderly.

The importance of respiratory changes during sleep is now recognized to extend far beyond the obstructive sleep apnea syndrome. Important phenomena occur in neonates, patients with chronic lung diseases and a host of neurologic diseases. In addition, the range of sleep disordered breathing transcends the confines of the usual medical concerns, from the mundane, associated with the common cold, to the exotic, such as the cyclic breathing of high altitude explorers.

This is an ambitious volume. We start with history and literature, followed by basic neuroscience. We dwell at some length on the relevant physiology, considering control of breathing during sleep in both adults and children and paying special attention to critical areas such as the control of the upper airway and the complexities of the response to hypoxia. The clinically oriented section explores the various sleep apnea syndromes and devotes considerable attention to diagnostic methodologies, again paying separate attention to the differences

between methods and entities in the adult and pediatric populations. We discuss current concepts of therapy from a mechanistic point of view and end with detailed descriptions of breathing abnormalities in chronic lung disease and neuromuscular disorders.

Our goal was not to be encyclopedic or to represent all points of view. Nevertheless, the scope of the work, stature of the contributors, and our encouragement to include as much text and references as “necessary” have resulted in most topics being presented in considerable depth. The addition of a few concise chapters makes the volume of likely interest to a broad segment of the potential audience. It is our expectation that the progress and new developments in this field will necessitate coverage by texts many times the size of this one in the not-too-distant future.

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Teodoro V. Santiago, M.D.

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# 1 Sleep and Breathing in History and Literature

*Philip L. Schiffman*

Sleep, next society and true friendship, man's best contentment, doth securely slip his passions and the world's troubles.

—John Donne

Since antiquity man has been fascinated by sleep. He has looked forward to it and has dreaded it, loved it and feared it, theorized about it and baffled over it. Throughout, he has never entirely understood it. This has been reflected over the centuries in folklore, literature, art, music, philosophy, theater, and medicine.

This introductory chapter explores these cultural records of man's theories and perceptions on the essence of sleep throughout the ages. As the breadth of two and a half millenia of ideas makes a comprehensive review impossible, this chapter will concentrate on select works of special interest within the following areas: the relationship of sleep to death, dreams, the nature and function(s) of sleep, and the relationship of sleep to health and disease.

## SLEEP AND DEATH

His life is a watch or a vision  
Between a sleep and a sleep

—Algernon Charles Swinburne  
*from Atlanta in Calydon*

From his earliest writings, we can see that man has perceived a close relationship between sleep and death. At times he has found them difficult to



**Fig. 1-1** Selene, the moon Goddess saw and fell in love with the handsome but mortal shepherd Endymion who was asleep on Mount Latmus. She visited him often and they had 50 daughters. In one legend, Jupiter offered Endymion a choice of punishments. He could die by any means he chose or he could live in perpetual peaceful sleep. Endymion chose the latter. In another legend, Selene put Endymion into a perpetual sleep so that he would never change. In either legend, Endymion still sleeps today in a state of perpetual youth and is still occasionally visited by Selene. Many second and third century A.D. Roman Sarcophagi have been found adorned by reliefs depicting this story. Above is a picture of part of such a relief from a second century A.D. Sarcophagus. Note Endymion asleep, staff in hand, his head resting on the lap of Somnus, god of sleep. To the right is Eros. To the left is Selene, the moon Goddess (a moon crescent on her forehead). Further to the left on the actual sarcophagus, but out of view of this picture, is a slumbering shepherd and his flock. (The Metropolitan Museum of Art, Fletcher Fund, 1924. [24.97.13])

distinguish as stated in the Bible, “The deepest sleep resembles death” (I Samuel:26:12) and in the Talmud, “sleep and death are similar. They are only different in degree, in that individual organs function more feebly: sleep is one-sixtieth (i.e., one piece) of death . . .” (Berachoth 576). Also, Aristotle<sup>2</sup> wrote, “Persons, too, who have fallen into a deep trance, and have come to be regarded as dead, . . .” This instilled in man both a fear of sleep (fear of dying while asleep) and a sense of hope (that death may not be final, but only a prolonged period, similar to sleep).

This perceived linkage between sleep and death can best be seen in mythology<sup>3,4</sup> (Fig. 1-1). Sleep (Hypnos in Greek mythology and Somnus in Roman mythology) and Death (Thanatos) are twin brothers, both sons of Night (Nyx). Hypnos brings mortals solace and fair dreams. The Dreams, whose numbers are infinite are sons of Hypnos. Morpheus, one of the sons of Hypnos (also called the god of dreams), is a molder or shaper of dreams seen by man and of man. Hypnos induces man to sleep by touching him with a magic wand

or fanning him with his wings. The cave of the abode of Hypnos lies in stillness and darkness by the River Lethe, whose murmuring waters invite sleep. His dwelling has two gates, one of ivory through which issues false and flattering visions and one of horn through which true dreams pass.

The god of sleep even has power over other gods, some mightier than he. This is seen in the *Iliad*<sup>5</sup>. Hera despised Paris and his Trojan people, but the mighty Zeus would not permit the Greeks to conquer them and thus their war was stalemated. Hera conspired with Hypnos to put Zeus to sleep so that Poseidon might interfere on behalf of the Greeks while Zeus slumbered.

In contrast to his brother, Thanatos closes the eyes of mortals forever. His abode lies by the River Styx which no mortal may pass and return.

The linkage of sleep and death can be seen over and over again in the works of William Shakespeare.<sup>6</sup> In *Macbeth* he calls sleep "the death of each day's life." Hamlet, in his famous soliloquy repeatedly equates sleep with death:

to die, to sleep;  
to sleep: perchance to dream: ay, there's the rub,  
For in that sleep of death what dreams may come . . .

In *Henry IV, Part II*, the king refers to the time of his death as when he will be "sleeping with my ancestors."

Like Aristotle, Shakespeare also believed that the very deepest sleep could mimic death and used this as an important device in the plots of two plays, *Cymbelline* and the well-known *Romeo and Juliet*. For example, in *Cymbelline*, Imogen, the king's daughter swallows what she believes to be a soothing potion in order to relieve the anxieties she has developed over the miscommunications with her banished husband. She falls into a deathlike sleep as the medicine is actually an exceedingly strong sleeping potion prepared by the court physician and she is mistaken for dead by her brothers.

Repeatedly, poets have referred to the dead as "the sleeping." This is seen in John McCrae's "In Flanders Field":

If ye break faith with us who die  
We shall not sleep, though poppies grow  
In Flanders Field.

This interchanging of the terms is also seen in several works that followed in response to "In Flanders Field." John Mitchell wrote in "Reply to In Flanders Field," "Oh! sleep in peace where poppies grow," J. A. Armstrong urged the dead to "sleep peacefully, for all is well," in "Another Reply to the In Flanders Field," and in "America's Answer" R. W. Lilliard wrote,

and we will keep  
True faith with you who lies asleep

with each a cross to mark his bed,  
In Flanders Fields.

Thus it is not surprising that sleep and death have been linked in our thought and language. A dead body is "laid to rest" and bid to "rest in peace" (rest implies a restorative function to sleep).

## DREAMS

When we dream we do not know that we are dreaming. In our dreams we may even interpret our dreams. Only after we are awake do we know we have dreamed. Finally, there comes a great awakening, and then we know life is a great dream.

—Chuang Tzu<sup>7</sup> (Fourth Century B.C.)

Undoubtedly no aspect of sleep has fascinated man more through the ages than dreams. Man has speculated on their causes and their meanings, postulating dreams to be a gift of (the) god(s) or to arise from within; he has considered dreams to be prophetic of the future, nonsense, or derived from the past. He has marvelled at their irrationality (Fig. 1-2). Life itself has even been thought of as a dream (not just figuratively in a song) with death an awakening (Chuang Tzu, above) or attributed to the dream of a superior being, Vishnu.

The Greeks disagreed on the origin of dreams. Herodotus<sup>8</sup> states that pictures arising in the mind while waking in the day may occupy dreams at night, but he also believed that the gods could give man warnings of the future in dreams. Galen believed that the soul created two kinds of dreams:<sup>9</sup>

The soul does not only form during sleep the sense data of the condition of the body, but also from the customary activities of the day: some of these are our thoughts, and some are disclosed by the soul as prophecies as can be proved by experience.

Aristotle<sup>10</sup> thought dreams to be the misinterpreted perceptions by the sense organs of both internal and external stimuli. Thus an innocuous sound could, during sleep, be perceived as thunder. Moreover, Aristotle thought that different personality types would perceive the same stimulus differently. His example is that a coward, in his dreams, would interpret as a threatening enemy what the amorous person, in his dreams, would interpret as an object of desire. Aristotle<sup>11</sup> however dismisses dreams as not having any prophetic meaning. He attributes those dreams that do come true to coincidence or foresight. He dismisses divine intervention as being the cause of prophetic dreams, as many dreams do not come true and argues that "common people" are just as likely to have their dreams come true, dismissing as absurd that a God would send a prophetic dream to any but the noblest and wisest.



**Fig. 1-2** *El sueño de la razón produce monstruos* by Francisco Goya is one of a series of engravings entitled *Caprichos*. This is a self portrait. When the artist sleeps, his mind's reason or rationality succumbs and he is engulfed in dreams of horrible animals and monsters. (The Metropolitan Museum of Art, Gift of M. Knoedler & Co., 1918.)



Through the ages the disagreements continued, varying on one hand, from the Roman, Epicurus, who denied dreams have any relationship to conscious or psychological processes, attributing them to atoms entering the sleeping mind from without<sup>12</sup>, to the modern western ideas of Freud who stated, "Every dream will reveal itself as a psychological structure, full of significance and one which may be assigned to a specific place in the psychic activities of the waking state."<sup>13</sup>

Dream interpretation and prophecy was important to the ancients. The Greeks, Aeschylus in particular, credit Prometheus (prometheus is Greek for foresight) as the founder of the "science" of dream interpretation. In "Prometheus Bound" Prometheus states:<sup>14</sup>

It was I who arranged all the ways of seercraft, and I first adjudged what things come verily true from dreams; and to men I gave meaning to the ominous cries hard to interpret.

In different eras and cultures the prophetic dream took different forms. It could be direct as it often is in the epics of Homer and Virgil, with a vision