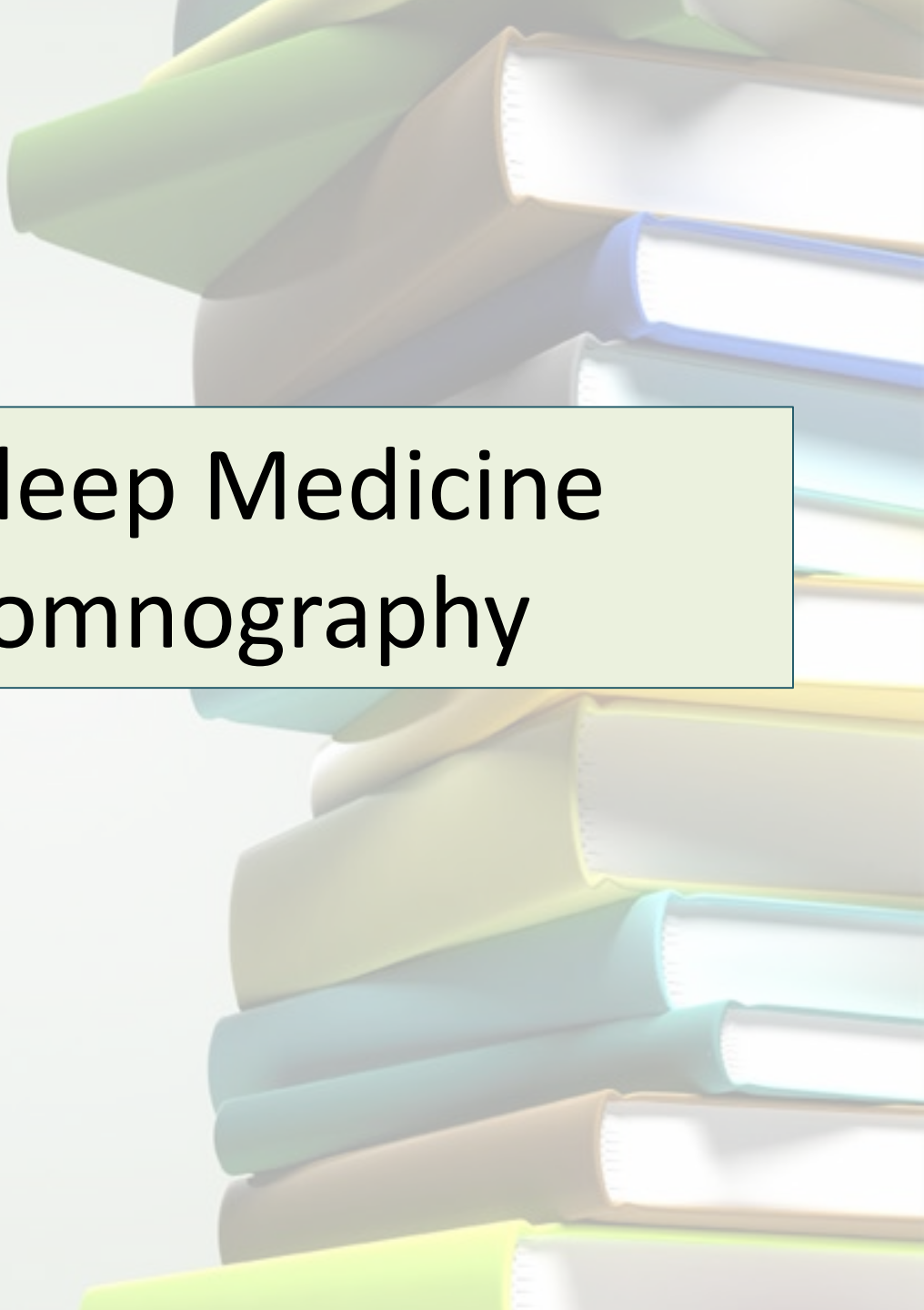
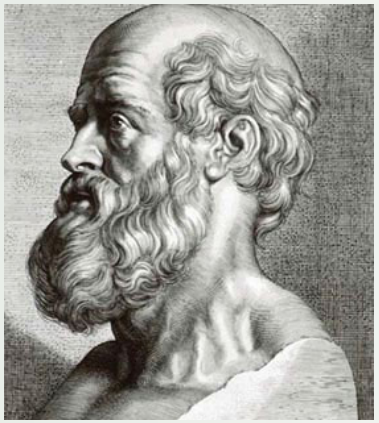
History of Sleep Medicine and Polysomnography



Overview

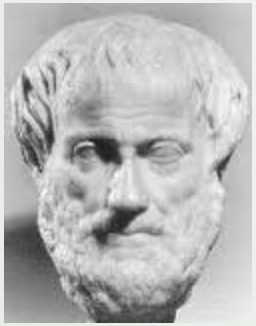
- “More has been learned about sleep in the past 60 years than in the preceding 6,000.” – J. Allan Hobson, *Sleep* (1989)
- Sleep research, emphasizing all-night sleep recordings, burgeoned in the 1960s – precursor of sleep medicine and polysomnography

Timeline



- 400 B.C. – Hippocrates wrote, “I have known many persons in sleep groaning and crying out, some in a state of suffocation, some jumping up and fleeing out of doors, and deprived of their reason until they awaken, and afterward becoming well and rational as before, although they be pale and weak; and this will happen not once but frequently”

- 360 B.C. – Dionysius, the tyrant of Heraclea
  - Historical documents describe him as immensely obese and record that he died "choking on his own fat"
  - His physicians may have used the first treatment of apnea – sticking needles through the skin to arouse him from sleep



- 350 B.C. – Aristotle wrote about sleep and waking, whether they are a function of the body or the soul, and the significance of dreams; Observed that all creatures sleep

- 1603 A.D. – Shakespeare
  - Describes sleepwalking in *Macbeth*, act 5, scene 1

    - "GENTLEWOMAN. Since his Majesty went into the field, have seen her rise from her bed, throw her nightgown upon her, unlock her closet, take forth paper, fold it, write upon't, read it, afterwards seal it, and again return to bed; yet all this while in a most fast sleep"
  - Character Falstaff – appears in 3 plays
    - Obese, snored, and fell asleep at inappropriate times – all symptoms of sleep apnea

- 1605 – Miguel de Cervantes Saavedra
  - In *The Ingenious Hidalgo Don Quixote of La Mancha*, described REM behavior disorder in Part 1, Chapter 35

    - "And in his right hand he held his unsheathed sword, with which he was slashing about on all sides, uttering exclamations as if he were actually fighting some giant: and the best of it was his eyes were not open, for he was fast asleep, and dreaming that he was doing battle with the giant."

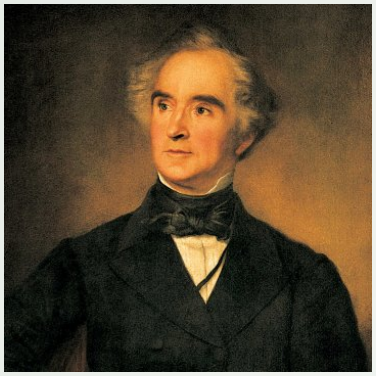
- 1672 – Sir Thomas Willis (of the circle of Willis) describes the features of restless legs syndrome. The condition does not receive a name until 1945.

- 1729 – Jean-Jacques d'Ortous De Mairan

  - First report of circadian rhythm
  - Conducted experiment using mimosa plant that opened leaves at certain time when sunny
  - Put plant in box with no exposure to light, and plant's leaves still opened at same time
- 1816 – William Wadd

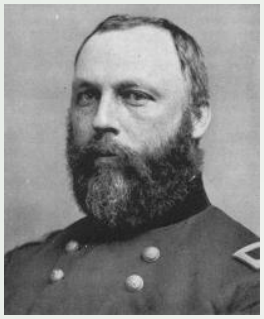
  - Surgeon Extraordinaire to King of England
  - Writes monograph "Cursory Remarks on Corpulence; or Obesity Considered as a Disease" which describes sleepiness in obesity
  - One case "became at length so lethargic, that he fell asleep in the act of eating, even in company"

- 1818 – John Cheyne
  - Describes breathing pattern named after him in “A Case of Apoplexy in Which the Fleshy Part of the Heart was Converted into Fat”
    - “For several days his breathing was irregular; it would cease for a quarter of a minute, then it would become perceptible, though very low, then by degrees it became heaving and quick, and then it would gradually cease again: this revolution in the state of his breathing occupied about a minute, during which there were about thirty acts of respiration.”



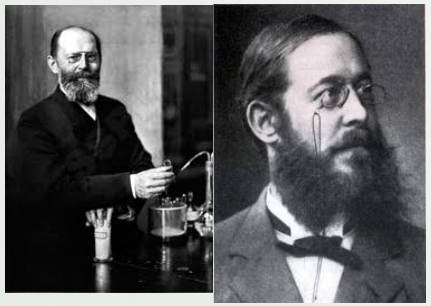
- 1832 – Justus von Liebig
  - Discovered chloral hydrate, perhaps the first widely used and abused hypnotic agent
- 1836 – Charles Dickens
  - Published *The Posthumous Papers of the Pickwick Club*
    - Book describes Joe, the fat boy whose symptoms of snoring and sleepiness form the basis of the first article to describe the Pickwickian syndrome, published in 1956

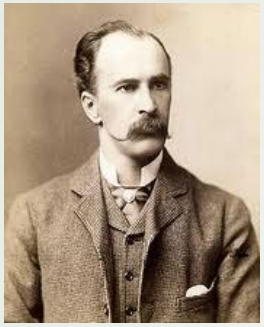
- 1864 – Adolf von Baeyer
  - Discovers barbituric acid, the parent compound of barbiturates
- 1869 – William Hammond
  - Publishes Sleep and its Derangements
  - Uses phrase “persistent wakefulness” to describe insomnia
  - Describes sleep state misperception, blaming the condition on increased blood flow to the brain
- 1875 – Richard Caton
  - Demonstrated electrical rhythms in the brains of animals
- 1877 – Karl Westphall
  - First to describe sudden bouts of sleeping associated with loss of motor tone



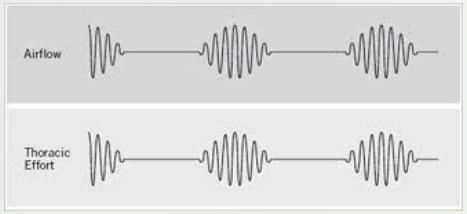
- 1880 – Jean Baptiste Edouard Gelineau
  - First to use the term “narcolepsy” to describe a disease with irresistible sleep

- 1895 – Nathaniel Kleitman is born
  - First and most famous sleep researcher
- 1898 – William Wells makes association of nasal obstruction and daytime sleepiness
- 1902 – Leopold Lowenfeld states narcolepsy is associated with cataplexy
- 1902 – Emil Fischer and Joseph von Mering
  - Synthesize barbital, first widely used barbiturate hypnotic



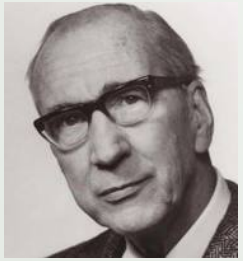


- 1918 – William Osler
  - In *Principles and Practice of Medicine*, describes sleeplessness and mental symptoms including drowsiness in congestive heart failure
- 1929 – Hans Berger first to record an electroencephalogram (EEG)
- 1934 – W.R. Harrison
  - Describes clinical consequences of Cheyne Stokes breathing in heart failure
  - Describes sleep onset, sleep maintenance insomnia, paroxysmal nocturnal dyspnea, and shows how periodic breathing pattern improves with treatment of heart failure

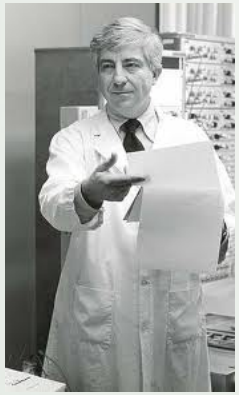


- 1935 – Alfred Loomis describes the EEG findings of “nonrapid eye movement” (NREM) sleep
- 1937 – Annie Spitz describes 3 cases of OSA in patients who have right heart failure, Cheyne Stokes respiration, snoring, and sleepiness

- 1939 – Nathaniel Kleitman publishes *Sleep and Wakefulness*



- 1945 – Karl-Axel Ekbom introduces the term restless legs syndrome and describes the condition



- 1949 – Giuseppe Moruzzi and Horace Magoun describe reticular activating system and the neurologic basis for wakefulness and arousal
- 1953 – Nathaniel Kleitman
  - At the University of Chicago, assigned grad student Eugene Aserinski to use eye muscle movements as a measure of depth of sleep and documented REM sleep
- 1956 – Sydney Burwell and others describe Pickwickian Syndrome
- 1957 – William C. Dement, coined the Father of Sleep Medicine, describes REM sleep in the cat

- 1959 – Michel Jouvet describes REM sleep atonia in cats
- 1960 – Allan Rechtschaffen explores psychophysiology of dreams
- 1960 – Gerry Vogel describes sleep-onset REMs in narcolepsy
- 1961 – Precursor of the Sleep Research Society is formed
  - Later becomes the Association for the Psychophysiological Study of Sleep (APSS)
  - Ultimately became Sleep Research Society

- 1963 – Richard Wurtman's group reports that melatonin synthesis in the pineal gland is controlled by light
- 1964 – Association for the Psychophysiological Study of Sleep is founded
  - Became precursor for Association of Sleep Disorders Centers (1975), American Sleep Disorders Association (1987) and ultimately American Academy of Sleep Medicine (1999)
- 1967 – Lawrence Monroe reports physiologic findings between good and poor sleepers, precursor to hyperarousal state

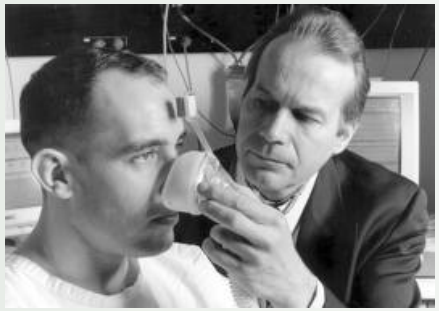
- 1969 – Allan Rechtschaffen and Anthony Kales produce a sleep scoring manual, which formed the basis of sleep staging for most research for the next 40 years
- 1970 – William Dement founds world's first sleep disorders center at Stanford University
- 1972 – The Rimini Symposium on Hypersomnia and Periodic breathing, held in Italy, is first major conference in which sleep apnea is main focus. Term "sleep apnea" had not been coined yet.

- 1974 – Hewlett-Packard introduces first fiberoptic-based ear oximeter.
- 1974 – Dr. Jerome Holland of the Stanford group gives the name “polysomnography” to sleep disorder diagnostic test
- 1976 – American Sleep Disorders Association is established. Name later changed to American Academy of Sleep Medicine.
- 1976 – Fred Turek and Michael Menaker establish that treatment with melatonin can alter the circadian clock of sparrows, laying foundation for use of melatonin and melatonin agonists as chronobiotic drugs today

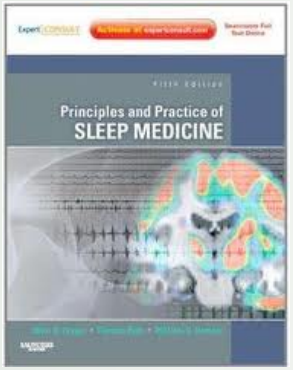
- 1976 – Mary Carskadon and colleagues report large difference between subjective and objective measures of sleep in insomniacs and showed that arousals increase with age
- 1976 – *Sleep Apnea Syndrome* is published
  - Contains papers presented at first American symposium on the disorder
  - Term *sleep apnea* first introduced by Christian Guilleminault's team in 1975

- 1976 – Charles Czeisler describes 24-hour cortisol secretory patterns in humans

- 1978 – First issue of journal *Sleep* is published, with Christian Guilleminault as editor
- 1981 – Colin Sullivan describes use of nasal CPAP in article in *The Lancet*

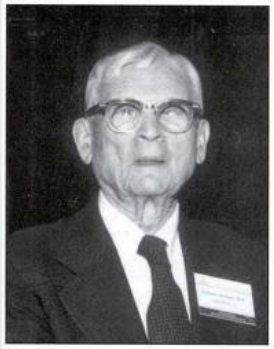


  - CPAP revolutionized treatment of sleep apnea, which up to that time was treated surgically, usually with tracheostomy
  - Other advancements made by David Rapoport and Mark Sanders
- 1982 – National Institutes of Health holds the first consensus symposium conference on insomnia



- 1986 – Sleep group in Minnesota, led by Carlos Schenck and Mark Mahowald describes REM sleep behavior disorder
- 1989 – Meir Kryger, Tom Roth and William Dement edit first comprehensive sleep medicine textbook
- 1990 – Michael Thorpy spearheads creation of first International Classification of Sleep Disorders
- 1990 – National Sleep Foundation is established in the US

- 1993 – US legislation establishes Center for Sleep Disorders Research at National Institutes of Health
- 1993 – Terry Young shows for first time that sleep apnea found to be extremely common among males. For first time high prevalence among females was shown. Up to that time, thought that sleep apnea was rare among females.
- 1995 – Nathaniel Kleitman gives a lecture at age 100 at the APSS



- 1996 – AASM granted a seat in House of Delegates of American Medical Association
- 1997 – Modafinil shown to be effective as a stimulant. Ultimately found to be an efficacious treatment in narcolepsy and later in excessive sleepiness.
- 1997 – Takahashi, Pinto, and Turek discover and clone first mammalian circadian clock gene, called *Clock*. Soon many circadian genes were found to be similar in flies, mice, and humans.

- 1999 – Eve Van Cauter demonstrates that sleep restriction can induce, in otherwise healthy people, physiologic and endocrine changes indicative of early sign of insulin resistance. This led to many studies to investigate relationship between chronic partial sleep loss and obesity, diabetes, and cardiovascular disease.

- 1999 – Following 10-year search, Emmanuel Mignot's group found that familial narcolepsy in dogs was due to mutations in the hypocretin receptor-2. Shortly after, a discovery at Stanford University found that most cases of human narcolepsy, with cataplexy and HLA-DQB1*0602 positive, are associated with a loss of hypocretin peptide in the cerebrospinal fluid and the brain

Sleep Seen Through the Eyes of History

- Sleep has been expressed in art and literature throughout history
- Something that has been difficult for mankind to understand the functionality of
- Many misconceptions of what happens during sleep
- Only in the last 50 years has sleep's function begun to be understood

Sleep in Art and Literature

- Depicted through mythology
- Depicted through religion
- Depicted as a state of rest
- Depictions of dreams, danger and death
- Viewers familiar with the stories behind the characters

Sandro Botticelli – Mars and Venus

- Sleeping Mars depicted as incapacitated, exposed, and vulnerable
- Likens sleep to weakness and humiliation

Piero della Francesca - Dream of Constantine

- Sleep depicted as state in which divine communicates with humans and the sleeper can realize higher states of consciousness

Jan Steen – The Dissolute Household

- The eye is immediately drawn to woman at the table in restful sleep amongst chaos
- Sleep seen as rest

Jean-Francois Millet – Noonday Rest

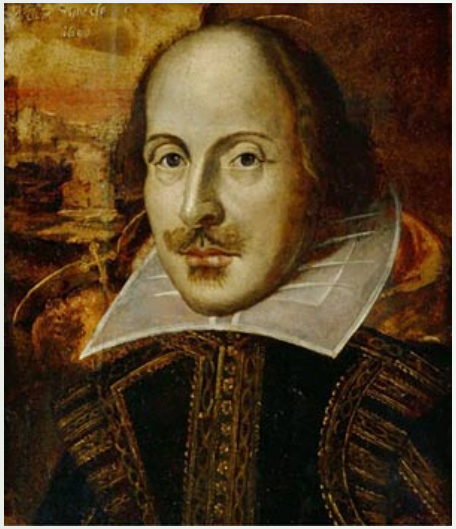
- Sleep seen as wondrous healing state of escape, rest and comfort – common artistic theme

Berthe Morisot – The Cradle

- Contrasts sleep and awake, unaware and alert, empowered and weakened

William Shakespeare

- Equated sleep with death
- *Hamlet*, act 3, scene 1:



To be, or not to be: that is the question. Whether 'tis nobler in the mind to suffer The slings and arrows of outrageous fortune, Or to take arms against a sea of troubles. And by opposing end them? To die: to sleep: No more, and by a sleep to say we end The heartache and the thousand natural shocks That flesh is heir to, --- 'tis a consummation Devoutly to be wish'd. To die, to sleep, To sleep: perchance to dream: ay, there's the rub: For in that sleep of death what dreams may come?

John Keats

- Equated sleep with rest

WHAT is more gentle than a wind in summer?
What is more soothing than the pretty hummer
That stays one moment in an open flower,
And buzzes cheerily from bower to bower?
What is more tranquil than a musk-rose blowing
In a green island, far from all men's knowing?
More healthful than the leafiness of dales?
More secret than a nest of nightingales?
More serene than Cordelia's countenance?
More full of visions than a high romance?
What, but thee Sleep? Soft closer of our eyes!

John Keats

Low murmur of tender lullabies!
Light hoverer around our happy pillows!
Wreather of poppy buds, and weeping willows!
Silent entangler of a beauty's tresses!
Most happy listener! When the morning blesses
Thee for enlivening all the cheerful eyes
That glance so brightly at the new sun-rise.

- From *Sleep and Poetry*