To sleep, per chance to dream.

Insomnia is a common problem. This chapter explores some of the background to sleep and how we might improve insomnia. It is important to have a realistic expectation about sleep as we get older but if you can function normally during the day then you don't have a significant problem. There is much we can to address insomnia and potentially cure it but no easy shortcuts.

Chapter outline.

Introduction.

There are several sleep abnormalities that include:

- Hypersomnia - excessive sleep.
- Narcolepsy - falling asleep at inappropriate times.
- Parasomnias - abnormalities during sleep such as sleepwalking, sleep talking, sleep paralysis, night terrors.
- Dream sleep disorders - thrashing, punching, jumping out of bed.
- Rhythm sleep disorders where the 24 hour clock is shifted. Normal variations are "night owl" or "lark."
- Sleep deprivation - lack of sleep that is imposed by some external factor that restricts the opportunity to sleep.
- Insomnia. This is by far the most common affecting 10% of all adults - a sense of inadequate quantity or quality of sleep which impacts upon daytime functioning.

Insomnia is the focus of this chapter and it is important to differentiate between insomnia, which is due to a factor within the body such as anxiety or sleep deprivation which is caused by an external factor. Lack of deep restorative sleep can impact on physical health but deep sleep is usually normal in insomnia and sleep deprivation is usually implicated. For example, shift workers demonstrate increased risks of cancer and diabetes.

Sleep is not always an all or nothing condition. Some animals can sleep with one side of the brain while the other shows the characteristics of wakefulness. This locally regulated process of sleep could explain how wakefulness can intrude into sleep, such as in sleep talking and sleepwalking. Reports of subjects being awake all night even though brainwave recordings suggest they have been asleep may also reflect this phenomenon. Conversely sleep can intrude into wakefulness, such as lapses of attention when we are sleep deprived, particularly dangerous when driving.

What happens during sleep?

Four types of sleep are recognised. These are identified by electrical brainwave activity and changes in physiological variables such as heart rate, body temperature, and muscle activity. The stages are divided into rapid eye movement sleep (REM) and three types of non-rapid eye movement sleep (Non-REM), which are progressively deeper. (See figure 3). Most dreaming occurs during REM sleep but can occur in non-REM sleep in a more simplistic form but why we dream is not known. [1]

- Non-REM 1 sleep. Dropping off to sleep -aware of surroundings.
- Non-REM 2 sleep. Can be woken easily.
- Non-REM 3 sleep. Deep sleep. If woken can be confused. The main beneficial effects of sleep and brainwave synchronisation occur in this phase. This is the good restorative sleep that we need.

[1] In 1900 Sigmund Freud suggested the dreams contain coded messages about repressed desires -windows to the "hidden self." and that "the interpretation of dreams is the royal road to a knowledge of the unconscious activities of the mind." An alternative view is that dreams are caused by random and spontaneous firing of brain networks. Our subconscious decision-making networks have difficulty in analysing these and send these experiences to conscious networks for further assessment.

- REM sleep. Light sleep with rapid eye movement, sexual arousal, muscle paralysis and dreaming. During this phase, transient awaking can occur, presumably from an evolutionary perspective to check on environmental activity.

These stages rotate through a cycle that lasts approximately 90 minutes. Typically, there are four cycles during the night with differing amounts of REM sleep. There is a degree of cultural influence on the overall architecture -some nomadic tribes undertake sleep cycles interspersed with periods of wakefulness, our mediaeval ancestors had two sleep periods.

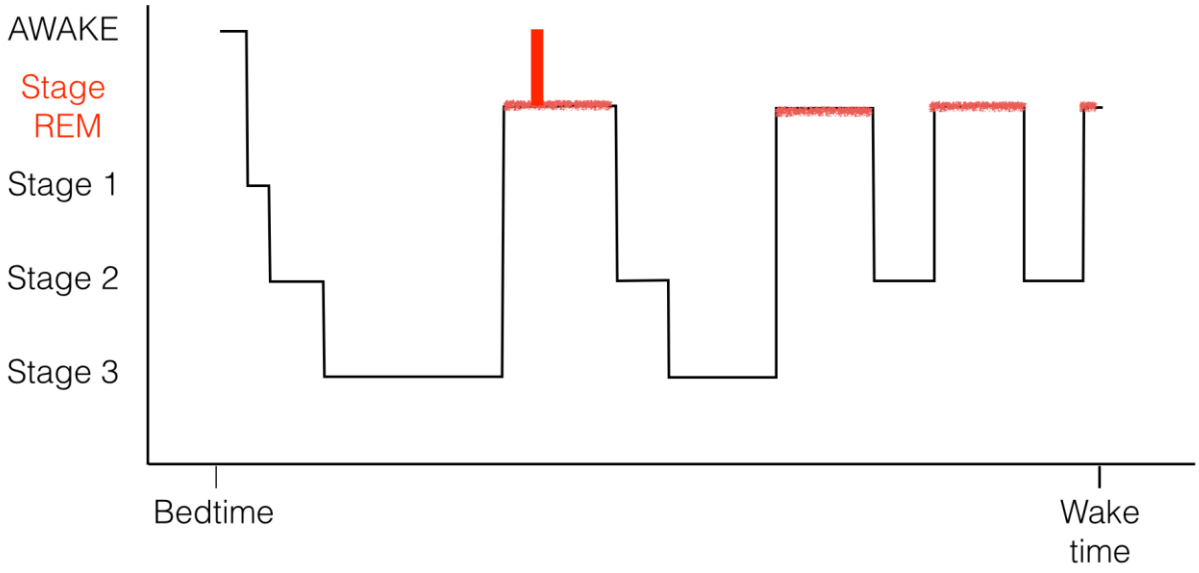

Figure 1. Typical sleep pattern during a night. The red lines are REM sleep with one period of transient awakening. The correlation with results from personal sleep trackers is poor. Stage 3 is the good stuff.

How much sleep do I need?

Adults need between 7 to 9 hours sleep a night, but there is a very wide normal range of between 4 and 12 hours. As we get older requirements are generally less but there are no recommendations. The key criterion for sufficient sleep is the ability to function normally during the day. Whatever sleep you get, if you can function normally during the day you do not have a problem.

But as we get older:

- Sleep efficiency is reduced. Sleep efficiency = Time asleep in bed/Total time in bed and should be over 85% in older people.
- Sleep becomes more fragmented.
- There is an increase in the number of awakenings.
- A reduction in stage 3 and increase in stage 2 sleep.
- A decrease in REM sleep and consequent dreaming.
- Daytime sleepiness can lead to unintentional napping and further deterioration in sleep quality.
- Secondary causes of insomnia are also more common as a result of increasing physical and mental illness and concurrent use of medications that can increase levels of alertness.

Insomnia - what causes it, how to treat it?

Insomnia is defined as a sense of inadequate quantity or quality of sleep which impacts upon daytime functioning due to factors arising within the body. The most common problem is difficulty in maintaining sleep, but other issues are difficulties in falling asleep and early-morning awakening. This results in reduced attention, sleepiness, fatigue and mood change during the day all of which can lead to significant impact on quality-of-life.

Insomnia can be transient lasting less than two weeks or chronic (lasting three nights a week over at least three months.) 10% of adults have chronic insomnia with women more affected than men. Insomnia is divided into two types depending on the cause of the problem.

Primary insomnia.

This is the most common form. There is usually a trigger or precipitant such as a stressful event that causes a complex arousal of the nervous system. Normally a transient insomnia occurs lasting approximately 2 weeks before sleep patterns returned to normal. However, in some cases this initial response can trigger physiological and psychological mechanisms that become perpetuated within a complex cycle of rumination, anxiety, depression, body dysfunction such as muscle tension and sleep problems. People with primary insomnia get an adequate amount of restorative stage 3 sleep but are deficient in stage 2 sleep, so the resulting consequences in terms of increased disease risk are not significant.

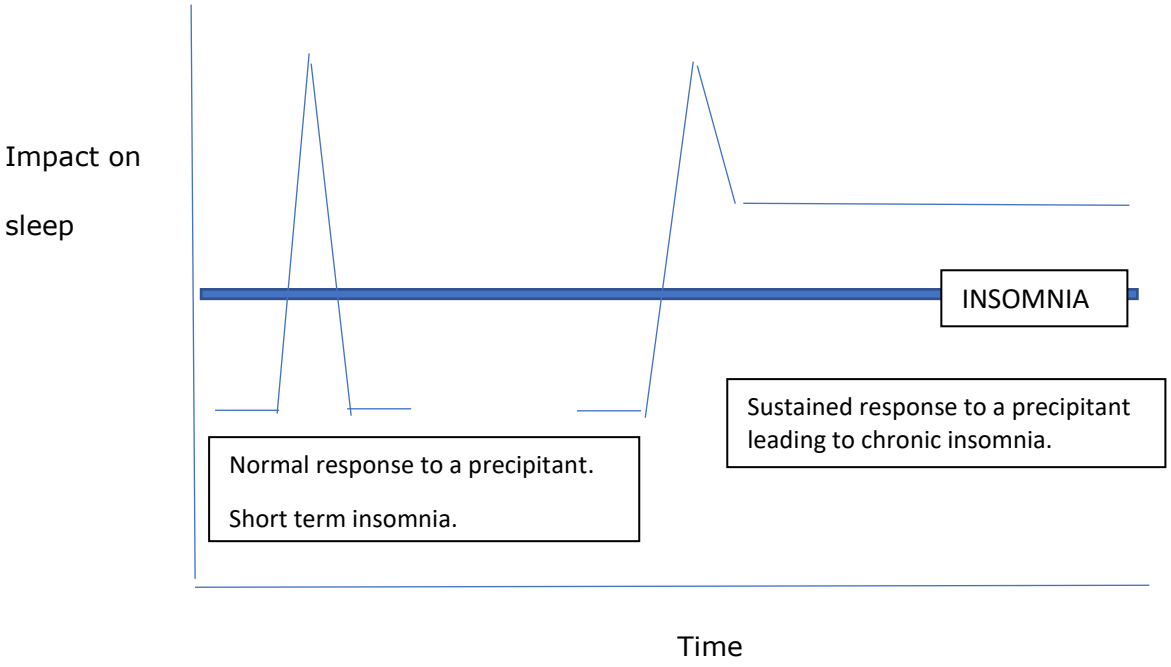

Figure 2. A primary insomnia occurs when there is a sustained response to a precipitant such as stress or bereavement.

Secondary insomnia.

This occurs when there is an ongoing identifiable underlying physical or mental cause:

- Pharmacological factors. For example, thyroid hormones, corticosteroids, decongestants.
- Mental health issues. Anxiety can cause difficulty getting to sleep and depression is characterised by early-morning waking.
- Medical disorders. A wide range of medical disorders are associated with insomnia. Three important ones are:

i). *Pain*. Any painful condition can be problematic at night when there are fewer surrounding distractions. Headache is particularly important as it shares several physiological mechanisms with sleep. Migraine and cluster headache can be problematic

at night while poor sleep patterns can exacerbate migraine. Problems that cause raised pressure inside the brain can be exacerbated by lying flat.

ii). *Restless leg syndrome*. The typical features are an urge to move or spontaneous movement (usually the legs), abnormal sensation such as burning tingling or "insects crawling under the skin." The cause is not known, but low iron can be implicated and certain drugs can exacerbate the problem. Specific drug treatment is available.

iii). *Obstructive sleep apnoea*. This is the cessation of breathing due to obstruction of the upper airway. Because of this the brain is continually alert at the expense of deeper sleep states. 1% of men are affected with a significant risk of having a road traffic accident and increased likelihood of diabetes and cardiovascular disease. It occurs mainly in those who are overweight and is characterised by snoring, nocturnal choking, daytime sleepiness, waking unrefreshed and morning headache. Weight loss and continuous positive airway pressure as the mainstay of treatment. Surgery and devices to maintain the airway are other options but the evidence for them is poor.

Figure 3. The continuous positive airway pressure mask is an important treatment for sleep apnoea. The mask fits over the nose and provides a positive pressure which maintains the upper airway open.

Treatment of Insomnia.

Any contributing secondary underlying cause should be treated appropriately. The degree of insomnia can be assessed by questionnaires. The Epworth sleepiness scale is most commonly used (https://www.esht.nhs.uk/wp-content/uploads/2017/08/Epworth-Sleepiness-Scale.pdf.) The StopBang questionnaire is the most appropriate for assessing obstructive sleep apnoea. (http://www.stopbang.ca/osa/screening.php).

Sleeping tablets.

Also known as hypnotics, a group of drugs known as Benzodiazepines (for example, Temazepam) were used widely in the past. However, they reduce time in non-REM sleep 3 (deep restorative sleep) and dependency can be a problem. The current generation of hypnotics (for example, Zolpiderm, Zopiclone) have fewer problems but there is concern that their effects can carry over into the morning. This is a problem in the elderly and can contribute to falls. A major concern is when older adults are up at night and motor coordination can be impaired.

Melatonin, a naturally occurring substance and important in the brain's biological clock, is less effective but very safe. Circadian 2mg is the only melatonin compound that can be prescribed within the NHS and can be used as a short-term hypnotic. Much smaller doses act as a timing signal to bring the sleep rhythm forward, for example, during jetlag. Melatonin bought without a prescription is invariably of poor quality and likely to be ineffective. Other prescription only sedating agents can be effective in specific circumstances such as depression and nightmares.

Sleeping remedies bought from a pharmacist directly usually contain an antihistamine which can induce sleepiness but they can last into the next day and tolerance can occur. Herbal medicines are usually based on Valerian with similar problems to antihistamines.

Hypnotics can be used for over short periods of time, for example, the transient insomnia that occurs as a result of a precipitant as outlined above. Whether they can "break the cycle" of chronic insomnia is more controversial but a short one-week course may be worth considering. In all cases there should be an exit strategy at the onset with a slow reduction rather than an abrupt cessation. This is particularly important in if hypnotics have been used for some time. For example, when sleep efficiency is 85% reduce dose by quarter every week and continue to reduce if this level of efficiency stays the same.

Psychological therapy - Cognitive behavioural therapy for insomnia. (CBTI).

A range of practical and psychological approaches, ideally delivered in a healthcare setting, have been combined under the label of CBTI and are as effective as hypnotics. Unlike hypnotics, CBTI can be curative. The focus is on changing behavioural patterns and addressing unhelpful ways of thinking. For example, having realistic expectations about sleep, not trying hard to sleep, preventing life revolving around sleep concerns and catastrophic thoughts about the consequences of insomnia. Mindfulness and self-hypnosis can be incorporated into insomnia treatment regimes but their evidence base is limited.

Other evidence-based practical approaches that may be helpful are:

Sleep hygiene. These are practical measures to control the environment and behaviours that are associated with sleep. Avoid alerting substances such as caffeine, nicotine and alcohol three hours before bedtime. (Although alcohol may be initially sedating it causes poor quality sleep and early-morning waking.) Engage in relaxing activities prior to going to bed, such as reading, listening to music, or taking a bath. Electronic devices, including TV are alerting. There is evidence that the light emitted from electronic screens can reduce melatonin and therefore the onset of sleep. Although social convention designates a sleeping partner, it may be better to sleep alone rather than have a disturbed night.

Lying in bed when you're awake can become a habit that leads to poor sleep. If you are not asleep after 20 minutes, or if you wake during the night for more than 20 minutes, get up, go to a place outside the bedroom and undertake a quiet, enjoyable activity such as reading or listening to music.

Stimulus control therapy. This method helps remove factors that condition your mind to associate bed with sleep. A good sleeper sees the bed as a place to sleep , the bad sleeper sees it as a torture chamber. Only use the bedroom for sleeping - no TV, no reading, no mobile phone or devices. It is a sleep room.

Sleep scheduling. This attempts to anchor the circadian rhythm or sleep cycle. Keep a sleep diary to estimate how much you're sleeping and how much time you're spending in bed. Add 30 minutes to the actual amount of time you sleep and this will now be your *time in bed*. Set a fixed waking up time and work backwards using your time in bed to set your time to go to bed. Use an alarm clock fixed your waking time. Keep to this regime, irrespective of how tired you may be with no lie ins.

This treatment reduces the time you spend in bed causing partial sleep deprivation. Avoid the temptation to go to bed before your set time, however tired you are. Once your sleep has improved, your time in bed can be gradually increased.

Napping is out. However, once an acceptable sleep pattern is established power naps of less than 20-30 minutes before 3 PM are acceptable and there is evidence that they can reduce cardiovascular risk. Longer naps can disturb body rhythms if deep sleep occurs when your brain thinks you should be awake. Naps lasting more than an hour can increase the risk of premature death.

Paradoxical intention. This involves avoiding any effort to fall asleep. Paradoxically, worrying that you can't sleep can keep you awake. Letting go of this worry can help you relax and make it easier to fall asleep. Keep to your usual routines, but when in bed. Keep your eyes open with an emphasis on trying to stay awake. Repeating mantras can

be useful. For example *"I'm doing these techniques to sleep better in the future. Things may get worse before they get better. There is no pressure."*

Relaxation techniques.

i).Progressive muscular relaxation. This is based on the premise that mental calmness results from physical relaxation. Muscles are tensed and relaxed, starting with the legs and working upwards. Tightly tense each muscle group for approximate five seconds and then relaxed for approximately 10 seconds. Exhale as you relax and focus on the difference between tension and relaxation. With practice you become more aware of your muscle groups, how they respond to stress and anxiety and how you can relax them with a beneficial effect. (see figure 7).

Foot (curl your toes downward)

Lower leg and foot (tighten your calf muscle by pulling toes towards you)

Upper leg (squeeze thigh muscles)

(Repeat on other side of body)

Hand (clench your fist)

Entire right arm (tighten your biceps by drawing your forearm up towards your shoulder and "make a muscle", while clenching fist)

(Repeat on other side of body)

Buttocks (tighten by pulling your buttocks together)

Stomach (draw your stomach in)

Chest (tighten by taking a deep breath)

Neck and shoulders (raise your shoulders up to touch your ears)

Mouth (open your mouth wide)

Eyes (clench your eyelids tightly shut)

Forehead (raise your eyebrows as far as you can)

Figure 7. A regime for progressive muscle relaxation

ii). Thought stopping. Articulatory suppression uses an irrelevant speech sound repeated out loud. For example repeating the word THE, THE,THE…..preferably with the eyes open.

iii). *The correct way to worry*. Our brains have not caught up with the demands of modern civilisation. One approach we use to reduce mental effort is to offload as much as possible from our brains to other storage devices such as mobile phones. There is no reason why we shouldn't do this with our worries and anxieties that invariably keep us awake.

This technique allocates a buffer zone during wake time and sleep time. This is ideally, an hour and a half before bedtime, during which your body and mind is moved to a relaxed state ready to sleep. See figure 8. This can be any relaxing activity, but a bath may be particularly helpful as increasing and reducing temperature can have a physiological benefit possibly mediated via melatonin. During this buffer zone, write down a list of what had gone well during the day and name any worry (Negatives first). Then what went well today. Writing is important and has been shown to deactivate an important part of the brain involved in anxiety. Then write down actions for the next day. Look at the action list in the morning and rate as do now, do some other time, delete.

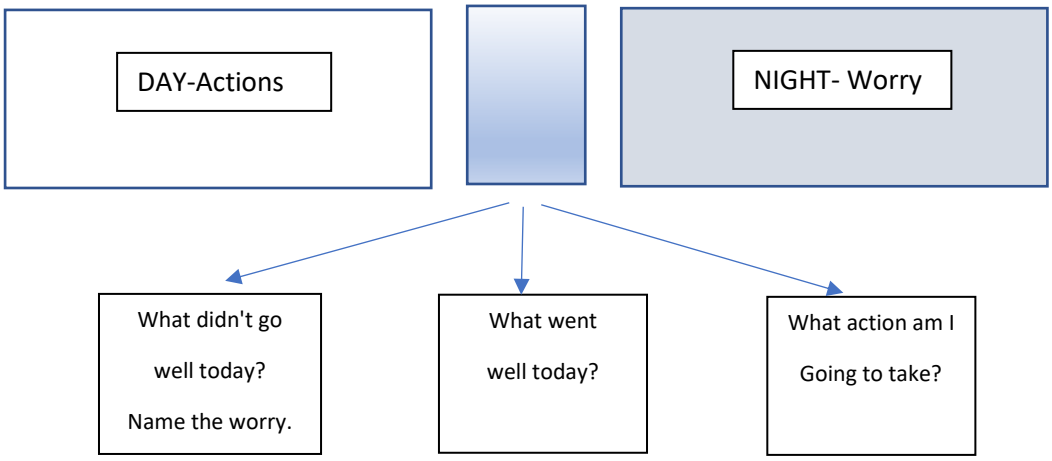

Figure 4. Offloading worries during the buffer zone.

Exercise regularly.

Maintain a constant sleep wake time. (Anchor the day.) Don't deviate from it.

Don't use the bedroom for anything else other than sleep.

Get out of bed if unable to fall asleep after 20 minutes.

No naps after 3 PM and no longer than 45 minutes.

Avoid caffeine, tobacco, alcohol in the evening.

Avoid electronic devices last thing at night. Offload your worries before going to bed.

Figure 5. Some basic rules for sleep.

Figure 5 summarises some basic rules for sleep. A wide range of Apps are available to facilitate sleep (for example CBT i coach) which may be useful. It has been suggested that noise at a frequency of around 15 Hertz can be helpful.

Conclusion.

Inevitably, sleep quality deteriorates with age. There are several positive actions that can be taken but it is important to have realistic expectations of what can be expected. If there is no impact on the ability to function during the day then whatever you do and what happens at night is not a worry. If insomnia is problematic there are a number of successful approaches to its management but no easy shortcuts.

I'm grateful to Dr David O'Regan for his comments on an earlier draft of this paper.

Further Resources

American Academy of Sleep Medicine. https://aasm.org/clinical-resources/practice-standards/practice-guidelines/

NICE guidelines. https://cks.nice.org.uk/insomnia

British Association of Psychopharmacology.
https://www.bap.org.uk/pdfs/BAP_Guidelines-Sleep.pdf

Appendix.

What is sleep for?

The body oscillates through a 24-hour rhythm driven by complex chemical and electrical oscillating networks. A master clock is located in an area of the brain called the hypothalamus and although the this synchronises with the day night cycle, in the absence of daylight it maintains a 24-hour rhythm. Figure 1 shows the wide range of systems that are under the influence of biological clocks and figure 2 how some different functions change with time of day. This can be useful to direct activity. For example, creative thinking, maybe best during initial sleep inertia in the two hours after waking but a sharp focus is best between 10.00-12.00 and not good between 2-4pm.

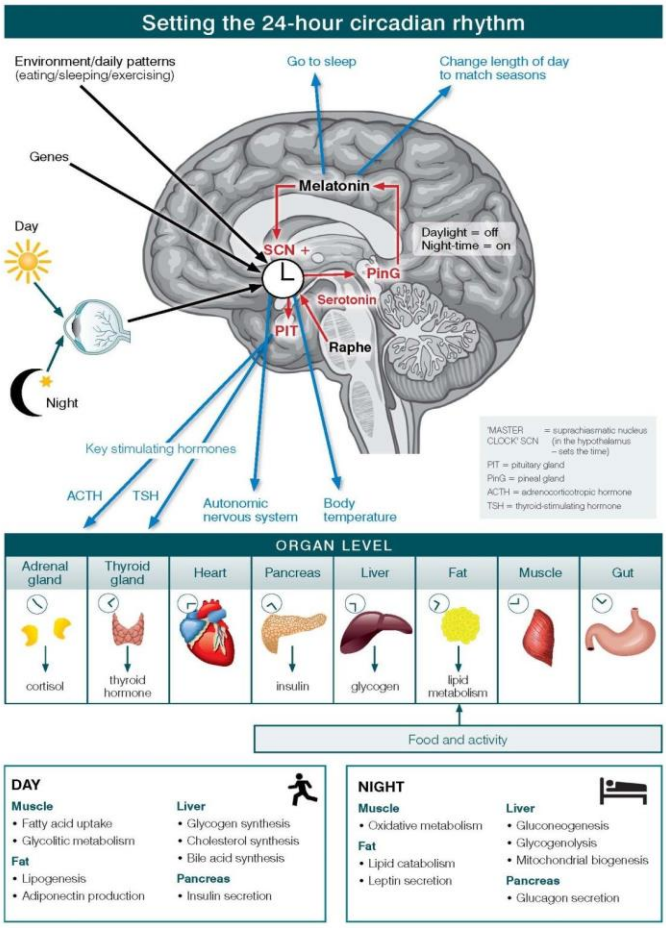

Figure A1. The complex control mechanisms that drive internal body clocks affecting a wide range of body activities.

07.30 - Melatonin secretion stops. 08.30 - Bowel movement likely.

10.00 - High alertness.

12.30 - Best coordination.

15.30 - Fastest reaction time.

17.00 - Greatest cardiovascular efficiency and muscle strength.

18.30 - Highest blood pressure.

21.00 Melatonin secretion starts.

04.40 -Lowest temperature.

06.45 Highest rise in blood pressure.-

Figure A2. Approximate timings of some biological functions.

Sleep is an important manifestation of these regulatory processes differing from other forms of unconsciousness such as coma. Although it only occurs in its recognised form in animals with complex nervous systems, sleep like states can be identified in all species and even microorganisms demonstrate rhythmic cycles.

Why we sleep is not known but it must have a significant evolutionary imperative to render animals so vulnerable during times of darkness. Some suggestions are:

- The consolidation of memories - during deep sleep there is a marked synchrony of electrical activity across the brain.
- The reorganisation of subconscious models. The phenomena of waking up with an answer to a problem or a new intuition is well recognised.
- Conserving energy and building up energy stores.
- Removing waste products from the brain.