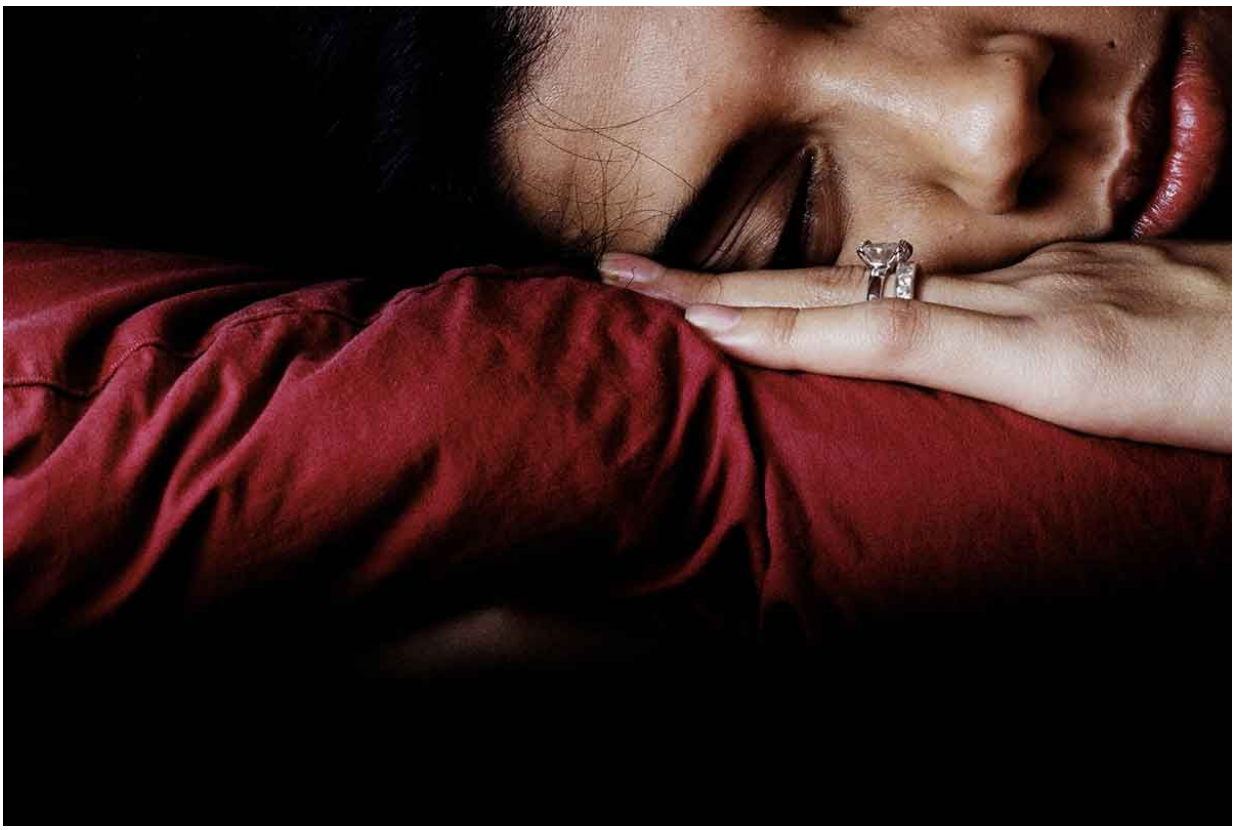
DAILY NEWS 12 July 2016

Mystery of what sleep does to our brains may finally be solved



Sleep tight to get your brain right
Julie Guiches/Picturetank

By **Clare Wilson**

It is one of life's great enigmas: why do we sleep? Now we have the best evidence yet of what sleep is for – allowing housekeeping processes to take place that stop our brains becoming overloaded with new memories.

All animals studied so far have been found to sleep, but the reason for their slumber has eluded us. When lab rats are deprived of sleep, they die within a month, and when people go for a few days without sleeping, they start to hallucinate and may have epileptic seizures.

One idea is that sleep helps us consolidate new memories, as people do better in tests if they get a chance to sleep after learning. We know that, while awake, fresh memories

are recorded by reinforcing connections between brain cells, but the memory processes that take place while we sleep have remained unclear.

Support is growing for a theory that sleep evolved so that connections in the brain can be pruned down during slumber, making room for fresh memories to form the next day. "Sleep is the price we pay for learning," says Giulio Tononi of the University of Wisconsin-Madison, who developed the idea.

Now we have the most direct evidence yet that he's right. Tononi's team measured the size of these connections or synapses in brain slices taken from mice. The synapses in samples taken at the end of a period of sleep were 18 per cent smaller than those in samples taken from before sleep, showing that the synapses between neurons are weakened during slumber.

A good night's sleep

Tononi announced these findings at the Federation of European Neuroscience Societies meeting in Copenhagen, Denmark, last week. "The data was very solid and well documented," says Maiken Nedergaard of the University of Rochester, who attended the conference.

"It's an extremely elegant idea," says Vladyslav Vyazovskiy of the University of Oxford

If the housekeeping theory is right, it would explain why, when we miss a night's sleep, the next day we find it harder to concentrate and learn new information – we may have less capacity to encode new experiences. The finding suggests that, as well as it being important to get a good night's sleep after learning something, we should also try to sleep well the night before.

It could also explain why, if our sleep is interrupted, we feel less refreshed the next day. There is some indirect evidence that deep, slow-wave sleep is best for pruning back synapses, and it takes time for our brains to reach this level of unconsciousness.

Waking refreshed

Previous evidence has also supported the housekeeping theory. For instance, EEG recordings show that the human brain is less electrically responsive at the start of the day – after a good night's sleep – than at the end, suggesting that the connections may be weaker. And in rats, the levels of a molecule called the AMPA receptor – which is involved in the functioning of synapses – are lower at the start of their wake periods.

The latest brain-slice findings that synapses get smaller is the most direct evidence yet that the housekeeping theory is right, says Vyazovskiy. "Structural evidence is very important," he says. "That's much less affected by other confounding factors."

Protecting what matters

Getting this data was a Herculean task, says Tononi. They collected tiny chunks of brain tissue, sliced it into ultrathin sections and used these to create 3D models of the brain tissue to identify the synapses. As there were nearly 7000 synapses, it took seven researchers four years.

The team did not know which mouse was which until last month, says Tononi, when they broke the identification code, and found their theory stood up.

"People had been working for years to count these things. You start having stress about whether it's really possible for all these synapses to start getting fatter and then thin again," says Tononi.

The team also discovered that some synapses seem to be protected – the biggest fifth stayed the same size. It's as if the brain is preserving its most important memories, says Tononi. "You keep what matters."

A shorter version of this article was published
in *New Scientist* magazine on 16 July 2016