fund/consciousness/notes nothing chapter 2 mysteries Banishing Consciousness Linda Geddes

Chapter 2, Secret Life of the Brain from the book *Nothing: Surprising Insights Everywhere From Zero to Oblivion*
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Anesthetics show great promise in helping to understand consciousness.
The development of general anesthesia has transformed surgery from a
horrific ordeal to a gentle slumber.

(remember we know the brain is active during deep anesthesia)
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People have long envisioned the brain as being like a computer on standby, lying dormant until called upon to do a task.
In 1953, physician Louis Sokoloff found that volunteer subjects brain consumed no more oxygen while doing mental
arithmetic than when resting with his eyes closed.
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The brain accounts for only 2 percent of body mass, consumes 20 percent of the calories we consume, doing, as far as we can tell,
absolutely nothing.

There is a huge amount of activity in the resting brain. The work of Marcus Raichle, a neuroscientist at Washington University in St Louis.
And others, has led to the discovery of a major system within the brain. This system fires up whenever the brain is otherwise unoccupied
And burns more oxygen, gram for gram, than the beating heart.
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Using PET, Raichle noticed that some brain areas seemed to go full tilt during rest, but quieted down as soon as a brain exercise was done.
Most shrugged this off as noise, but it was found to be a consistent pattern. The activity occurred in a cluster of regions arching through the
midline of the brain, from front to back, dubbed by Raichle and Gordon Shulman the “default network”.
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It was initially assumed that this activity was for daydreaming.p. 20

But now people suspect the default network does more than just daydream. Michael Greicius at Stanford studied the default network using
fMRI. This led him to find what are called resting state fluctuations in the default network; slow waves of neural activity that ripple through
the network in a coordinated fashion. The waves lasted 10 to 20 seconds from crest to crest, up to 100 times slower than typical brain waves from an EEG.
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It was found that this neural activity in the default network was present in heavily sedated monkeys, as well as in sedated humans. Other researchers

Found the network active and synchronized in early sleep. This derailed the idea that the default network was all about daydreaming.
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Researchers have since found that the default network's pattern of activity is disrupted in patients with Alzheimer's, depression, attention deficit
hyperactivity disorder (ADHD) autism and schizophrenia. It also plays a mysterious role in victims of brain injury or stroke who hover in the grey
netherworld between consciousness and brain death. You can see how the network breaks down as coma deepens.
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It is one of the commonest medical procedures in the world, but we still don't know how the drugs work.

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The process of going into and out of consciousness is more akin to a dimmer switch.

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One of the big mysteries has been how the members of such a diverse group of chemicals could all lead to unconsciousness. Many drugs work by binding to receptor molecules such that the drug and receptor fit like a key and lock. Yet the long list of Anesthetics ranges from large molecules to inert xenon gas, which exists as atoms. how could they all fit the same lock?
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The potency of anesthetics correlate with their solubility in oil, but they can bind to proteins in the absence of fatty cell membranes. Protein receptors have been found for many anesthetics, but we still don't know how this binding affects nerve cells, and which neural paths they feed into. "If you look at the brain under both xenon and propofol anesthesia, there are striking similarities. " says Nick Franks of imperial College, London. They must be triggering some common neural change.

Many anesthetics are thought to work by making it harder for neurons to fire. fMRI studies have shown several areas that are deactivated by most anesthetics. However, so many regions have been implicated that it is hard to know which, if any, are the root cause of loss of consciousness.

But is it even realistic to expect to find a discrete site acting as the mind's "light switch"? The so called "global workspace" model states that consciousness is a more widely distributed phenomena.
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In this model incoming sensory data is first processed locally in separate brain regions without us being aware of it. We only become conscious of the experience if these signals are broadcast to a network of neurons spread across the brain, which then start firing synchronously p. 80

PSN: Note this synchronous firing could also be described as "coherent" in the quantum sense.

EEG recordings have shown that as consciousness fades there is a loss of synchrony over the cortex.

fMRI scans have shown that although small islands of cortex light up in response to external stimuli when people were unconscious, there was no spread of activity to other areas.

Normally it takes about 10 seconds to fall asleep after a propofol injection. Andreas Engel at the

University Medical Center in Hamburg has slowed down the process by lowering the dose. At each stage he gives a mild electric shock to the volunteers wrist and takes EEG readings.

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We know that upon entering the brain, sensory stimuli first activate the primary sensory cortex. Then further networks are activated, including frontal regions controlling behavior, and temporal regions that are important to memory storage. Engel found that at the deepest levels of anesthesia, the primary sensory cortex was the only region to respond to electric shock.. “Long distance communication seems to be blocked, so the brain cannot build the global workspace,” says Engel. The data suggests that the anesthesia agent interferes with communication by causing abnormally strong synchrony between them. “If too many neurons fire in a strongly snychronized rhythm, there is no room for exchange of specific messages.”

There is both forward and backward signaling between the different areas. EEG studies on anesthesized animals suggest it is the backward signal between these areas that is lost. This was shown to be important in people too. The backward signals recovered at the same time as consciousness returned.

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