on before the mask appears is enough for meaning to be extracted.

Combined with brain imaging, such studies show that activity in the region concerned with word recognition is not sufficient for consciousness. Instead, Dehaene reveals, conscious experience depends on interactions between sensory regions and the parietal and frontal areas of the brain. This is one of four neural signatures of consciousness that he lists.

These findings could be key in diagnosing locked-in syndrome, a state resembling coma in which a person is fully conscious, but unable to demonstrate it. Using brain-imaging techniques, it should soon be possible to detect consciousness in suspected cases: if a person with the syndrome imagines making a movement, for example, changes in brain activity linked to that could be detected.

Dehaene's special contribution is his global-workspace theory, the first step in a complete account of why some neural processes lead to conscious experience. The brain contains a number of discrete modules specialized for specific tasks, such as visual perception and motor output. Dehaene shows that for advanced cognitive processes — such as seeing things from the viewpoint of others — information generated by these modules must be maintained, manipulated and understood by several or all of them. The 'global workspace' is the virtual arena, created by long-range, synchronized neural connections, in which this happens. Only information that can be shared between modules enters consciousness. Effectively, without such conscious access, higher cognitive abilities would not be possible: consciousness is, Dehaene argues, no steam whistle.

I am not completely convinced that a global workspace is sufficient for consciousness. I believe that the ability to tell people about our experiences, as when tasting wine for example, is a crucial feature. However, our reportage is often erroneous, and that does not seem compatible with the precision needed for the information broadcast in Dehaene's global workspace. Nevertheless, Dehaene's account is the most sophisticated story about the neural basis of consciousness so far. It is essential reading for those who want to experience the excitement of the search for the mind in the brain. ■

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MEDICINE

Bad medicine

Alison Abbott reviews an exhibition that reveals a lag in applying academic knowledge to medical practice.

A nineteenth-century amulet used to guard against tooth ache and other ills.

DEUTSCHES MEDIZINHISTORISCHES MUSEUM INGOLSTADT

Johannes Magirus enjoyed special status in Zerbst, southwest of Berlin, in the mid-seventeenth century. As the town's only academically trained physician, he treated rich and poor alike — and loved to impress the social elite with the breadth of his learning, from physics to astrology.

Magirus is one of eight physicians practising between the seventeenth and nineteenth centuries whose working lives are featured in *Praxiswelten* ('Practice worlds'), an unusual exhibition at the Berlin Medical History Museum. Anatomical knowledge increased dramatically over this time, and understanding of physiology and infection biology began their catch up in the late nineteenth century. As medicine became more scientific, barber-surgeons gradually gave way to university-trained physicians. But as this exhibition shows, the transition to scientific medicine was slow, perhaps because patients clung to the magical beliefs of other healers.

Praxiswelten showcases ongoing research by a consortium of medical historians who scoured libraries and the countryside for unusual source material: the original notebooks of doctors in German-speaking regions of Europe. It comes as a jolt to see that the notebooks are written in Latin. Also surprising is the enormous detail with which physicians recorded symptoms and the circumstances of patient visits. The notebooks reveal the very individual personal styles of the doctors, who, although exposed to modern knowledge at university, rarely applied it in daily practice. They tended to refer instead to imbalances of the four 'humours' of antiquity — black bile, yellow bile, blood and phlegm — or more recent theories not based on science.

For example, Friedrich von Bönninghausen, who opened his practice in 1864 in Münster, relied exclusively on homeopathy — despite having trained in Bonn and Berlin, the most prestigious German-speaking centres of medicine at the time. His notebook shows that he treated 11,500 people up to 1889, but he lost patients in droves thereafter. The germ theory of infectious diseases had emerged in Europe by then, thanks to the work of Louis Pasteur and Robert Koch, and public-hygiene measures such as using clean sources of water had proven so effective that scientific medicine gained in popularity.

In remote regions, neither physicians nor patients had it easy. The ill often had to send urine samples and descriptions of their symptoms using messengers, who needed to be fit. Franz von Ottenthal opened his practice in 1847 in the Alpine Ahrn Valley. His notebook records that he prescribed extract of meadow saffron as a painkiller for one Josef Brugger. But the treatment caused burning sensations in the stomach, as Brugger's messenger informed von Ottenthal. Von Ottenthal sent her back with the advice that Brugger supplement his treatment with sodium bicarbonate and powdered rhubarb. Whether that helped remains unrecorded, but the messenger had to trek a total of 26 rugged kilometres.

Back in 1653, Magirus claimed success in treating a toddler suffering from fever cramps with a range of strange medicines and ointments. The child's father was rich enough to pay for as much as Magirus's renowned knowledge could deliver. The physician consulted specialist literature, and used his mathematical skills to calculate the positions of stars and planets, applying his remedies when the celestial bodies were most propitiously aligned. The exhibition makes one wonder anew that 'alternative therapies' remain so popular today. ■

Praxiswelten
Berlin Medical Historical Museum
Until 21 September 2014.

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