Part I
Chapter 1
The Neurological Study of Religion

I.1 The Natures of Neurology and Religion

The Discipline of Neurology
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The History of Neurology

Neurology is the branch of medicine that deals with disorders of the nervous system. The subject started, in its modern form, with the work of Thomas Willis in seventeenth-century England, as mentioned by Joanna Collicutt in Chapter 2. Willis studied the effects of diseases (for instance stroke) of the brain in people in life, and compared these with their anatomical effects at post-mortem. From these observations, he systematically assembled an account of the hierarchical nature of the nervous system from the peripheral nerves to the spinal cord, and then on through an ascending series of structures in the brain. This clinico-pathological tradition reached its apogee in the work of Jean-Martin Charcot in late nineteenth-century Paris (Clifford Rose 1999). Since then, the imaging and laboratory sciences have increasingly informed our understanding of the normal function of the brain and its diseases.

A key concept, for the purposes of this volume, is that different parts of the brain are specialised for different functions. Thomas Willis proposed this, and since his time opinion has swung from the extremes of localisation (the idea, for instance, that one neuron in your brain is responsible for ‘recognising’ your grandmother) to the ‘equi-potential view’ (where all parts of the brain are equally involved in all brain function). The current view is that distinctive brain functions are subserved by separate networks of anatomical structures.

Most of the conditions described in this volume are due to damage of the brain. But day-to-day neurology also encompasses illnesses affecting the whole nervous system: the brain, the spinal cord, the nerves going to and from the muscles and sensory organs.

The Humdrum Neurological Consultation

At the heart of the practice of neurology is an encounter between two experts. The patient is an expert in his or her symptoms, their impact on his or her life and, in the light of this, their goals for treatment. And the neurologist is expert in interpreting symptoms, signs on examination and tests, to arrive at a diagnosis, prognosis and suggestions for treatment.

This encounter is a humdrum business. Behind the consultation door, the patient describes their experiences, not always completely and not always fluently, often hindered in this by anxiety. And the neurologist listens, sifts, probes and reassembles the story to create hypotheses about which part of the nervous system may be impaired (the ‘where’) and which pathological process might be occurring (the ‘what’). These hypotheses are then tested in a focused physical examination. So, a story about difficulty walking may lead to a
careful examination of the limbs and eye movements (which may reveal damage to the balance centres of the brain); whereas wasting in one hand leads to tests of sensation around the armpit (indicative of damage to the nerve root that supplies the muscles in the hands). Usually, at the end of this process, the neurologist has recognised a pattern of symptoms and signs that points to one or two possible diagnoses. Tests may be needed to confirm the diagnosis or discriminate between alternatives, but their importance is usually overestimated by patients; for instance, it is perfectly possible to diagnose three prevalent neurological conditions (Parkinson’s disease, multiple sclerosis and epilepsy) by modern criteria, without doing a single test. There follows a discussion about the diagnosis, and its implications for the future, and possibilities for cure or control of the underlying health condition and amelioration of its symptoms.

This process is not restricted to doctors. Any professional treating someone with diseases of the nervous system will go through the same process. Physiotherapists, occupational therapists, speech and language therapists and clinical psychologists, must start by understanding their patient’s experiences, before interpreting how they relate to the underlying disorder and whether they might be alleviated. In so doing, whether consciously or not, they are also neuroscientists.

Learning from Experiments of Nature

We have learnt much about brain function from studies of animals in the laboratory, for instance about visual pathways from experiments in cats and motor control from monkeys. But there are some distinctive human capacities and experiences that cannot be studied in this way. Consider, for example, language. For several hundred years, the mechanism by which the brain mediated language could only be studied by observation of focal brain disorders. Tumours and strokes which lead to problems with speech, reading or writing – though personally disastrous – illuminate how language is organised in the human brain. Another sad source of information for neurologists is the consequences of accident, such as the tamping iron of Phineas Gage (Harlow 1868) (teaching us about the role of the frontal lobe in personality), and war, for instance the gunshot wounds of the First World War (revealing the anatomy of vision) (Holmes 1945). As John Hughlings Jackson, the great nineteenth-century British neurologist, put it: neurologists ‘alone witness the results of experiments of disease on the nervous system of man’ (quoted in Penfield 1955).

And so, an ‘atlas’ of patients’ experiences following damage to different parts of the brain has been accumulated. This is of interest to the anatomy enthusiasts, but others might reasonably ask: so what? It is non-controversial to say that the brain is involved in experience, so what is there to learn from the distorted experiences of people with acquired brain injury?

The first lesson to be learned from such patients is how humans fractionate experience and function. To return to language, it is perhaps not surprising that brain segregates the understanding of language (the temporal lobe) from the production of speech (close to the tongue area of the motor cortex). But it is profoundly interesting that the memory for names of inanimate objects seemed to be stored separately from the names of living things and foods (Warrington and Shallice 1984). And bizarrely, a stroke may lead to someone speaking their native language perfectly – but in a foreign accent (Tomasino et al. 2013). These observations raise questions about why humans would distinguish tools and accents in this way.
Another important lesson is the lived experience, over decades sometimes, of patients with neurological deficits. In the last 20 years, structural and functional imaging of the brain has provided an exciting way to study the healthy brain at work, but this can only document changes that occur over minutes. But the neurology clinic can report on literally a lifetime's experience of living with a neurological deficit. Philosophers can do the 'thought experiment' of contemplating life without memory, and functional images can study the anatomy of memory in a healthy brain. But only the life of people like 'HM' – who had parts of both temporal lobe removed in an attempt to treat his epilepsy – can teach us what it is like to live without the ability to lay down new memories for decades (Augustinack et al. 2014).

A Neuroanatomy Primer

For those unfamiliar with the brain, a little anatomy is needed. The basic unit is a 'neuron' or nerve cell (Figure 1.1A). There are 100 billion of these in the brain. The nerve cell sends out little fibres ('dendrites') to receive signals from other nerves (possibly up to several thousand) and sends out one long branching fibre ('axon') to carry electrical signals to other nerve cells. The longest of these fibres connect the top of the brain to the muscles of the feet. Making some big assumptions about the average length of axons, if you laid out all the neurons in the brain in a row, they would stretch for 1 million kilometres.

Where nerve fibres meet, there are specialised connections for the flow of electrical and chemical signals called 'synapses'. These are like signal boxes in a complicated railway network indicating 'go' or 'no go'. There are 10 trillion synapses in the human brain.

The varied functions of the brain are achieved by specialisation in two domains. Firstly, nerve cells themselves come in all sorts of shapes and sizes, with tiny little nerve cells extending a few micrometres to do the relatively simple job of connecting nerve cells in the same region ('interneurons') to the favourite, the majestic oak-like Purkinje cell of the
cerebellum, whose complex and systematic connections subserve the difficult task of coordinating movements. Secondly, different areas of the brain specialise in different tasks; so a neuron in one part of the brain can mediate some aspect of vision whereas a similar-looking nerve cell a few centimetres away is preoccupied with hearing. In this case, it is the sources of information to the neuron and its regional connections that determine its function.

The next level of organisation of the brain are ‘networks’: the local or regional arrangement of nerve cells. For instance, in the retina (Figure 1.1B) the receptors are connected to the retinal ganglion cells, which carry the output of vision, by a series of intermediary neurons which modulate the activity of neighbouring ganglion cells. Thus there is some processing of the photoreceptor signalling within the retina itself. The ganglion cells then send out their axons in a bundle, called the optic nerve, which then connects, via some relay nerves, to the part of the brain which mediates the perception of vision (the occipital cortex). The complex intertwining of nerves and fibres, making up these networks, are then folded in upon themselves into larger structures.

We can subdivide the gross structure of the brain. There are two ‘hemispheres’ which connect by a broad strap of nerves (the corpus callosum). Mostly these hemispheres are mirror-opposites: the right hemisphere controls movements of the left side of the body and vice versa. However, there is specialisation between the hemispheres; for instance, usually the brain mechanisms underlying language are in the left hemisphere. Each hemisphere can be divided into four: the frontal, parietal, occipital and temporal ‘lobes’ of the brain (Figure 1.1C).

Localisation and the Mereological Fallacy

The experienced neurologist is aware that symptoms can arise from any level of the nervous system: from a molecular defect, overstimulation of a neurotransmitter receptor, damage to nerve fibres, compression of the spinal cord, stroke affecting one region of the brain, psychological stress, psychiatric disorders, malingering and social dysfunction. As Daniel De Haan kindly says in this volume (Chapter 6), neurologists often traverse these layers competently, searching for the most fruitful point of intervention, which might be – among others – medication, an operation, counselling, cognitive-behavioural therapy or simply reassurance. But, not all are so skilful. As Roger Barker and Clare Redfern point out in Chapter 10, there is a literature which suggests that Parkinson’s disease may reduce scores in measures of religiosity. This has been wrongly interpreted as indicating that the disease affects a ‘spirituality centre’; more cautious investigators have considered that lower scores may be because impaired mobility from the disease leads to reduced attendance at religious services.

The principle of ‘double dissociation’ allows complex functions – such as language – to be fractionated and localised. For example, lesions of part of the frontal lobe rob people of the power of speech, but they can understand others perfectly; whereas damage to the superior temporal lobe means people can speak fluently, but there is no understandable content and they cannot comprehend others. But that does not mean that speech production depends only on the frontal lobe, nor does understanding solely reside in the temporal lobe.

Consider a lesion in structure X which means people cannot do function Y, so function Y is mediated by structure X. This is as logical as this statement: without the key, a car cannot move, therefore it is the key which moves a car.
A philosophical corrective to the localisations of the clumsy neurologist comes from an important book, *Philosophical Foundations of Neuroscience* by Bennett and Hacker (2003), to which several authors in this volume refer. They argue that the *mereological fallacy* is the mistake of attributing psychological qualities to specific anatomical structures rather than to the whole person. Experience from treating neurological diseases supports this view. As well as correcting any biochemical or anatomical disruption, if possible, the therapist will also seek to promote repair, regeneration and plasticity, to minimise impairment; and also encourage the patient to reframe their disability and adapt their life to minimise its impact. In this way, the whole person can re-establish healthy living despite significant impairment.

**Humility and the Boundaries of Neurology**

Like any discipline, neurology is circumscribed. The neurologist rightly has much to say about the business of diagnosing and treating a neurological disease. And he or she has a duty to report back to neuroscientists observations which enlighten our understanding of brain function.

But neurologists are neither philosophers nor theologians. Occasionally, however, chutzpah and hubris drive neurologists to misuse their expertise to support (for instance Andrew Newberg) or denigrate (Michael Persinger) religious and spiritual claims. The self-defined field of ‘neurotheology’ is largely made up of such embarrassments. The most a neurologist should and can comment on is the human business of believing, experiencing and practising religious lives.

**References**


