Phineas Gage and the beginnings of neuropsychology

1848 was a year of political revolutions in Europe. In the same year, in the field of neuroscience, a freak occurrence would also prove - eventually - to have a revolutionary impact. Few neurologists will be unfamiliar with the name of Phineas P Gage, nor with the extraordinary work-related accident which befell him on the afternoon of 13 September 1848 in Burlington, Vermont, USA.

Gage was an unremarkable 25-year-old railroad worker, considered by many as a reckless, profligate young man. On this day, he was working in the track with blasting powder, in his capacity as a railroad foreman, an accidental ignition caused a tamping iron approximately 1.1 m (43 inches) long, 3 cm thick at its widest point, and weighing 15 pounds, to smash through the side of his head, entering just below the cheekbone, and emerge from the top of his skull, landing some 25-30 yards away smeared with brain. Gage was thrown back, a few convulsive movements of the extremities were observed, but he was able to speak within a few minutes.

Fewer neurologists may be familiar with Dr John Martin Harlow, the railway physician who attended Gage within two hours of the accident. Harlow continued to treat Gage in the following days when death from infection seemed imminent. He then continued to observe the changes in Gage's personality, up to the time of his death from status epilepticus in 1861. Moreover, it was Harlow who persuaded the family to permit examination of Gage's skull five years after his death (no post mortem was performed). Harlow published his findings in two papers, without which record Gage might not be remembered at all.

Gage's skull was subsequently donated to the Warren Anatomical Museum at Harvard University School of Medicine. Modern neuroimaging techniques have been used to study Gage's skull and reconstruct the probable path of injury caused by the tamping iron. This has permitted more precise definition of the lesion location, and suggests that both left and right prefrontal cortices were injured. As Harlow's account records in detail the behavioural changes manifested by Gage after the accident, and is still regarded as one of the best accounts of behavioural disorder following prefrontal damage, clinical-anatomical correlation is possible. From an efficient and capable work foreman, Gage became irreverent, capricious, profane and irresponsible, and showed defects in rational decision making and the processing of emotion, such that his employers refused to return him to his former position. Harlow argued that the frontal lobe lesion had caused a loss of planning skills. These neurobehavioural changes, sometimes labelled "pseudopsychopathic" or "sociopathic", are now regarded as typical of orbitofrontal injury, having been observed in other patients with selective lesions of this area.

However, other case histories indicate the need to differentiate this paradigm shift - a "natural experiment" which demonstrated the possibilities of correlating particular personality and behavioural changes with injury to focal brain regions, and hence the correlation of function with location. This practice continues in modern neuropsychology, where detailed case histories may be compared with structural and functional neuroimaging findings to help elucidate the workings of the brain.

References