In September 1892, only a few weeks after being graduated M.D. from Edinburgh, the young 24 year-old Australian Alfred Walter Campbell saw an advertisement in the *British Medical Journal* for exactly the kind of position he sought:

LANCASHIRE COUNTY ASYLUM, Rainhill, near Liverpool.—Pathologist. Salary, £200 per annum, with furnished apartments, board, attendance, and washing. Applications to the Medical Superintendent.

Campbell applied and was appointed as Assistant Medical Officer and Pathologist on 12 October. He remained at Rainhill for 13 years with only changes of title: in 1893 to Pathologist and Special Pathologist in 1894. At the time of his appointment, Rainhill was best known for its size and was well on its way to becoming the largest Asylum of its kind in Britain, if not in Europe. Through the museum built up largely by Campbell, Rainhill’s collections became famous in Europe. Campbell was to give it another distinction, that for research into the histopathology of mental illness, and especially through his pioneering investigation of the minute structure of the brain in relation to its functions.

When Campbell’s main Rainhill work was published by way of a subsidy from the Royal Society (London) in 1905 it immediately established him as the international authority on the cytoarchitectonics of the brain. After his death that status was confirmed by the Committee of the American Neurological Association including him in its list of 146 of the most outstanding neurologists of the 19th Century. Yet Campbell is barely known today to those specialising in the localisation of brain function, even in the country of his birth.

Campbell left little personal material from which to reconstruct his life or his work. In 1904 he had an account of his training in what was emerging as the discipline of psychiatry printed for a job application; in the early 1930s he wrote a short and somewhat fanciful history of the Campbell’s; and in 1937, the year of his death, he compiled a list of his

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publications, some of which were accompanied by a summary of the work. But, apart from a partial record of his histological work with Henry Head (held among Head’s own papers!), his official correspondence with the Royal Society, and a proof copy of his major work, there are no letters, diaries, or drafts of anything he wrote. Nonetheless it has proved possible to make out a framework for his life and fill in some of the details. Here I set out some of the basic facts about him and his work, especially that conducted at Rainhill, and which gained him and Rainhill its research reputation. So, let us begin.

**Beginning at the beginning**

Alfred Walter Campbell’s beginnings are in his mixed Scots, Danish, and French Huguenot ancestry. His Scots great-grandfather, John Campbell, married a Dane, Elisabeth Sophie Berg, in Copenhagen in 1796, and his grandfather, Thomas, thought to have been born in 1804 in Copenhagen, also married another Dane, Helena Maria Elisabeth Fiellerup, in the Danish East India Company’s colony of Tranquebar [Tharangambadi] India in 1826. One of their sons, David Henry Campbell, who had gone to New South Wales (NSW) to work for his uncle, Severin Knud Salting, the holder of some of the most extensive grazing properties in that State, was Alfred Walter’s father. David Henry was to marry Amelia Margaret Breillat, the daughter of a wealthy French Huguenot business man in Sydney, in 1856. By that time, David Henry had had 10 years experience managing his uncle’s sheep stations and the couple went as manager of Salting’s sheep station, ‘Goimbla,’ near Eugowra in New South Wales some 340 km west of Sydney.

An attack on ‘Goimbla’ in 1863 by Ben Hall’s gang of bushrangers was to give Alfred Walter a unique position among neuroscientists, possibly among scientists of any kind: his father shot and killed one of the members of Hall’s gang, John(ny) O’Meally. A consequence of the attack was that the family moved to another of Salting’s properties, ‘Cunningham Plains’ near Murrumburrah some 400 km south-west of Sydney. It was there that Alfred Alter Campbell was born on 18 January 1868.

We know nothing of Alfred Walter’s early education except that it was not at the nearby Cunningar public school, which his father had been instrumental in having the State authorities establish, and may have been through a tutor or governess employed by the family. We do know that from about the age of 11, he spent six years at Oaklands School in Mittagong, some 200 kilometres east-north east of Murrumburrah. Run by Henry Edmund Southey, who described himself as ‘late Demy Magdalen College’, Southey was said to be a relative of the English poet
Robert Southey and aspired to provide an education for boys ‘from families of more considerable means.’ That it did so provide is evident from the families of its pupils, and that it was basically a ‘classical’ education is evidenced in Gilbert Murray being a pupil - and Murray was the most noted English-speaking classical scholar of the twentieth century - and in Campbell’s examination results at Edinburgh. There was an equally strong emphasis on sport with the school competing in local and Sydney rugby and cricket matches. It is also said that the tennis court laid out there in 1875 was the first in Australia.

It seems to have been at Oaklands that Alfred Walter Campbell decided on medicine as a career and to pursue it at Edinburgh. There was then a good deal of dissatisfaction among medical students at the two older Australian medical schools of Melbourne and Adelaide, and the third, Sydney’s, had begun teaching only in 1883. Many medical students therefore chose to train outside of Australia. Campbell left Sydney on R.M.S. Potosi on Saturday 28 March 1885. He travelled in the Saloon (i.e. First Class) for which the single fare was £70.00, about half of what it cost to live in Edinburgh and pay University fees for a year. The date of his arrival in England is not known, because the inbound passenger list, like many others for 1885, is missing from the UK Public Records Office.

On 5 October 1885 Campbell sat Edinburgh’s ‘Preliminary Examination for Degrees in Medicine,’ which was an alternative to the more usual requirement of a BA. Although he had had only six years of education at ‘Oaklands’ he must have been confident about his academic ability because we know he played the first of three games of cricket only six weeks after Potosi berthed, the last of which was only six weeks before the application. Those teams consisted mainly of Australian and New Zealand medical students and Campbell top scored with 36 in one game. His examination results justified his confidence in finding time to play cricket: Latin and Greek (both ‘B’ or Good); French and Elements of Mathematics (both ‘S+’ or Very Satisfactory); English, Arithmetic, and Elements of Mechanics (all ‘S’ or Satisfactory); and Logic (‘S–’).

Campbell participated fully in Edinburgh’s student life, especially as a member of the Edinburgh-Australasian Club which he represented in student affairs and for whom he played cricket and rugby. He was graduated M.B. and C.M. four years after admission, on 1 August 1889, and in his non-professional examinations he obtained a number of

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3 University of Edinburgh, Medical Degrees, Preliminary Examination Results, A. W. Campbell, 29 October 1885.
medals. However, his overall results did not reach second class honours level as is sometimes said.4

The particular influences that led to Campbell’s choice of a specialisation are also unknown but they seem to have acted early. He spent the session preceding his being graduated M.B. and C.M. at University College Hospital, London, and said in 1904 that it was after graduation that he ‘promptly decided to devote [his] life to research in the province of mental science.’ Oddly this retrospective account has contemporaneous confirmation in the Sydney Morning Herald of 9 November 1889. It reported Campbell’s being graduated and his first appointment before saying ‘It is we believe his intention to retain this post for 12 months only, and then to attach himself to several of the leading Continental hospitals for another 12 months prior to returning to the colony.’ In fact, within the period late 1889 to early 1890 Campbell held two appointments in succession as Assistant Medical Officer (AMO) in County Asylums. He was elected an ordinary member of the Medico-Psychological Association on 13 March 1890 and a few months later passed the Association’s examinations for the ‘Certificate of Efficiency in Psychological Medicine,’ thus giving him the equivalent of today’s Fellowship of the Royal College of Psychiatrists. During this period he also had contact with John Hughlings Jackson at Queen Square although, as he put it, it was only that of ‘a newly fledged graduate and ward follower.’5

Consistent with the 1889 Sydney Morning Herald report, Campbell also said in 1904 that it was after his M.B. and C.M. that he began preparing himself for a career in a large institution that would combine administrative experience with research opportunity. He went to Vienna where he worked in Heinrich Obersteiner’s pathology laboratory and at the Vienna Asylum with Richard von Krafft-Ebing, and also attended the clinics and demonstrations of Salomon Stricker, Theodor Meynert, and Hanns Kundrat. Campbell then took up an appointment with Arnold Pick, the Director of the Prague Royal Infirmary, and had an attachment to the German University’s Pathological Institute under Hans Chiari where he completed his M.D. work. He took Ferdinand Hüppe’s formal course in ‘Sanitary Science’ (i.e. bacteriology). At age 24 he returned to

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4 Nothing quite as convenient as today’s student transcripts seem to have existed at Edinburgh in the 1880s and early 1890s. This list of subjects and results is from Campbell’s 1904 job application but to the extent that more ‘official’ records exist, they corroborate what he said in A.W. Campbell, ‘Application for the office of Inspector-General of the Insane in the State of Victoria, Australia, with testimonials’, Historical Library, Royal Australasian College of Physicians, Sydney. Ms. Box 57 Item 10a, 1904b.

Edinburgh where, on 1 August 1892 he was graduated M.D. for his Prague research.\textsuperscript{5}

It is sometimes said that Campbell was awarded the, or a, Gold Medal for his M.D. He never made the claim and it is not true. Campbell’s thesis was one of five in 1892 ‘Deemed worthy of competing for Gold Medals,’ that is, graded immediately below the Gold Medal.\textsuperscript{6} We can say that if neither his entrance examination nor his M.B. and C.M. results portrays him as the young genius of some later accounts, his M.D. does foreshadow a much higher status.

Campbell had not chosen a path promising an easy journey. Since the mid-1880s there had been so many complaints about the employment conditions of Assistant Medical Officers that four of them - the Drs. Dodds, Strahan, Greenlees, and Wiglesworth - were appointed by the Council of the Medico-Psychological Association to investigate and establish the facts. The first three presented the results of their 1888-1889 survey at the Quarterly Meeting of the Association in November 1889 (Wiglesworth had been promoted to the Superintendency of Rainhill in the interim).

Dodds, Strahan, and Greenlees devoted most of their report to the problems of Senior Assistant Medical Officers. The Junior AMOs, whom they regarded as ‘birds of passage’ on their way to other work, had, they said, taken on the job in order ‘to acquire that grave and senior look deemed essential in the private practitioner.’ Things were different with the Seniors. They had worked in asylums for between 5 and 10 years, were devoted to the speciality, and felt their knowledge of it and the responsibilities they exercised were not accorded proper consideration. Much of the work of AMOs was of a routine clerical kind and its heavy load left little time for scientific work. Their pay was much lower than that in the Army and Navy, which required similar duties and which paid retirement benefits. In the discussion one superintendent had asked rhetorically what qualities Superintendents looked for and, according to Strahan, answered, ‘I do not think they care very much whether he spends the rest of his time in going to dinner parties or in looking at sections through the microscope.’ The remark was greeted with laughter and applause. Had Campbell known of the discussion, neither the remark nor the response to it would have encouraged him, especially as the

\textsuperscript{6} These are Campbell’s own 1904 descriptions of his European studies and work. That he worked in Prague between November 1891 and February 1892 with Chiari is evident from the cases he reports in his M.D. thesis and first papers, but I have been unable to confirm the other details.

triumvirate’s recommendations were not acted on. The same issues arose four years later. Then an anonymous ‘Late A.M.O.’ solemnly warned ‘any young medical man, unless physically incapacitated from practising his profession in any other way, against entering asylum life.’

Because they were so well-known, the Rainhill AMO advertisement did not mention the restrictions applying to the position: applicants had to be under 30 years of age, had no right to private practice, and had to be and remain single. Were an AMO to marry he would almost certainly be dismissed. The minimalist salaries, sometimes of less than £100, would also have deterred AMOs from marriage. Campbell was lucky to start at £200 and by 1902 to have been propelled to the dizzy heights of £237.10.0.

Campbell’s living and working conditions at Rainhill were primitive in the extreme. The year before he arrived, the Commissioners in Lunacy described the AMOs’ quarters in their annual report thus: ‘These rooms require doing up, as does also the passage, and the furniture is absolutely worn out, worse than the furniture in any of the wards, which in many stands in need of repair’. Things moved slowly. Of the next year, during which Campbell moved in, the Commissioners could say only they were glad ‘to hear that the Assistant Medical Officer’s quarters at the Main Building are at once to be put into proper order.’ We do not know what facilities existed at Rainhill in 1892 for research, either general pathological or histological, but Wiglesworth was keen to promote research. Apart from the Dispenser, who also acted as photographer, there were no specially built or equipped facilities until the Rainhill Pathological Laboratory was constructed and equipped with money allotted in 1899, opening in 1902.

Rainhill did offer some compensation for an AMO’s Spartan existence, particularly in theatre and sport. Visiting local troupes provided plays, light opera, and musical recitals. Thus in his Annual Report of 1903 Wiglesworth thanked five Liverpool bodies for performances that had been ‘fully appreciated by the patients.’ Although each of the bodies was amateur, notices in the Liverpool Mercury put them squarely at the professional level. Sefton Park’s Pinafore at the Asylum, for example, was ‘a capital presentation’ and detailed reviews of

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9 Commissioners in Lunacy Annual Reports, 47th for 1891, p. 199 and 48th for 1892, p. 222; Liverpool Mercury, Friday, 24 November 1899 and Report of the County Lunatic Asylum at Rainhill 1903, p. 12; Rainhill Staff Changes Book, Liverpool Public Record Office M614 RAI/39, pp. 31, 51; Commissioners in Lunacy Annual Reports, HMSO, 49th for 1893, p. 253 and 50th for 1894, p. 280.
its other productions were equally positive (Liverpool Mercury, 18 February 1896; 24 November 1900). Some productions drew on the patients and staff. The 1894 performance of Sheridan’s The Rivals, for example, came entirely from within the Asylum, with Henry Head designing some of the sets and costumes. Even light operas were put on: Wiglesworth writing of the ‘very successful’ 1902 Spring run of La Mascotte (by Achille Edmond Audran) having been ‘got up by the Asylum Staff.’

Sports of various kinds were played and Campbell was prominent as a cricketer in matches in which Asylum teams took part. In fact, the first game for which I have found him noticed was when Rainhill Asylum played Garston in the Liverpool District competition early in July 1893. That Asylum team included three other doctors, and Campbell, although lbw for 8, took 5 wickets. At first he also played regularly for the local Rainhill side but soon transferred to the Huyton Cricket Club in the village of Huyton, about 6.5 km away, where he became a prominent member. Two surviving summaries site Campbell’s place within the Huyton club. In 1899 he made a total of 320 runs in 17 innings, including one of 100, for a mid-position average of 18.14. He took a total of 8 catches and his several stumpings show he sometimes kept wicket. In 1904, when he was busy finishing his cytoarchitectonic studies, he managed only 11 innings but had a total of 329 (highest 64), an average of 37.66, and he took 2 catches. Generally his playing was highly praised by the press, which used phrases such as ‘vigorous innings,’ ‘capital innings,’ ‘meritorious,’ ‘rare form,’ and ‘brilliant’ in describing it. And, in commenting on his batting against Birkenhead Park in June 1900, the Liverpool Mercury wrote, ‘Campbell hit lustily, and in his 39 were included eight 4s.’

An item from the BMJ’s ‘Medical News’ reveals a further and distinct advantage for Campbell to play away from the Asylum:

We regret to learn that, while on the cricket field at the Hull Borough Asylum, recently, Dr. Merson, Medical Superintendent, was rendered unconscious by a violent blow to the back of the head with a cricket bat, by one of the inmates. His condition for some time caused much anxiety, but he is now making slow but steady progress. (BMJ, ii (1897), 320).

Playing in the local district competition removed Campbell from such danger.

10 Knowsley Archives, Huyton Cricket Club, KA29/C/Z/1-10, Miscellaneous.
**Going on**

Alfred Walter Campbell not only conducted his own research at Rainhill. He seems to have been responsible for establishing its Museum of slides and casts and specimens of brains. Unfortunately we do not know what it contained: neither the architectural plan or the building itself can be identified, those few of its 4,000 odd specimens that have survived as slides in the Liverpool Public Record Office are unlabelled, and its catalogue, if there ever was one, has disappeared. Yet it was an integral part of Rainhill’s tool for teaching University of Liverpool medical students about mental illness, and became famous in England and Europe because of the displays from it that were mounted at various medical meetings.

It was also at Rainhill that Campbell entered into what was to be a fateful collaboration with Henry Head (1861-1940) that established the neurological reality of Head’s until then hypothetical dermatomes. The brief version of what happened is that Head went to Rainhill in December 1894 as an unpaid Clinical Clerk apparently to extend his research into the connection between mental and physical illness. Having published on the mental symptoms that sometimes accompanied physical illness in normals, he seems to have wanted to look at the problem from the other side. At Rainhill he made copious notes on the physical symptoms in various classes of mental illness but the work was not completed, or at least never published.

In mid-1895 Head’s attention returned to his 1892 M.D. research, on which he had also published. He found that the bands of tenderness in visceral disease followed fairly precisely the pattern of eruption and bands of tenderness in herpes zoster (shingles) even though there was no direct connection between the viscera and the nerves inflamed in shingles. He inferred that the bands, which he called dermatomes, revealed the innervation of the pain receptors on the skin provided by sensory nerves connected to specific sections of the spinal cord. The problem was that the dermatome was an entirely hypothetical concept. At the time the pathology of herpes zoster was not well-known, there were few data on the nervous supply to the skin, and virtually none on the connections of the viscera with the skin.

Head turned to Campbell for help in establishing the neuropathology of shingles and the two of them conducted some 21 post-mortem studies of the spinal nerves of patients who had had shingles before death and for whom the pattern of eruption had been recorded. Nearly all these 21 studies were done by Campbell, and certainly the first three, and Head clearly wanted to denigrate Campbell’s contribution. In 1896 he announced to the Medical Research Club that he would report on
the first two cases and originally failed to mention Campbell as a colleague. In his private correspondence Head also twice referred to Campbell as his ‘co-adjutor,’ that is, as a mere helper or assistant and definite inferior. That their paper is now regarded as a classic is more due to Campbell than to Head.¹¹

Campbell’s own research career began with the work he did in Prague for his Edinburgh M.D. which, from the dates of the publications to which it gave rise, was written up at Rainhill. His topic was a condition first fully described in 1822 by James Jackson (1777-1867), the Harvard Professor of the Theory and Practice of Medicine, although Jackson had been anticipated by Benjamin Rush. Rush had said the disease was known as Jamaican rheumatism and was caused by excessive rum drinking. By Campbell’s time it was called ‘alcoholic neuritis’. Symptoms began with pain and numbness in the hands and feet and gradually moved to a virtual paralysis of the extremities. Jackson attributed the symptoms to the overuse of ‘ardent spirits,’ that is to poisoning by distilled spirits. Little authoritative histopathological investigation had been carried out since Jackson and opinion was divided, in the usual binary way, between those who argued the changes were peripheral and those who believed they were central. Campbell showed conclusively that both were wrong: the condition was not a neuritis but a general degeneration of the nerve cells, the nerve fibres and their sheathings, and the blood vessels. For him the degeneration was a pure parenchymatous one similar to the secondary degeneration seen in a nerve cut from its central connection. Although he knew of Korsakoff’s contrary finding, Campbell agreed with almost every other writer that alcohol was the cause and that it acted as a toxin.¹²

Campbell’s first Rainhill research was, in a sense, a continuation of this Prague interest and was into the pathological changes in General Paralysis of the Insane (GPI). In the literature there was something of the same binary divide as with ‘alcoholic neuritis.’ As Campbell put it, the earliest literature had concentrated on the cerebro-spinal changes and, while more recent work had been directed to the peripheral nerves, there were other parts of the neuromuscular system that had not been examined adequately. Hence he made a comprehensive study of almost every part of the nervous and muscular systems: the cranial nerves and the nuclei in


the brain from whence they originated; the nuclei in the mesencephalon, the pons, and medulla oblongata; the spinal cord and its nerve roots; the mixed spinal nerves, the motor twigs to the biceps and other muscles; the sensory branches of cutaneous nerves; the various muscles, and the purely sensory and motor terminal branches of the mixed nerve trunks.

In everything he examined Campbell found the same kind of parenchymatous degeneration as in alcoholic polyneuritis, with the pneumogastric or vagus nerve ‘extensively and strikingly diseased.’ The vagal changes were much more marked than in almost ‘any of the peripheral nerves, and decidedly more so that any cranial nerve.’ Moreover, they were similar to those known to be caused by toxins. From the ‘marked affection of the small blood vessels accompanying the nerves’ found in other types of neuritis, Campbell concluded that the changes were pathogenically like only that of primary intrinsic toxæmic neuritis. His demonstration of the changes was so convincing that he won the first prize of a Bronze Medal and 10 guineas in the 1893 essay competition of the Medico-Psychological Association.\textsuperscript{13}

In 1893 Campbell did not go beyond suggesting that GPI had a toxæmic basis. Six years later, when he was then asked to introduce a discussion on the relation between syphilis and GPI at the Bournemouth meeting of the British Medical Association, he was more definite. From what he called ‘adequate data’ on 227 of the 312 patients admitted to Rainhill with the diagnosis of GPI, he concluded that syphilis was certainly or probably present in 86% of the males and 97% of the females. His figures matched those from a study by the Finnish alienist Emil Hougberg (1857-1909) of 98 male and 9 female patients in the asylum at Lappvik, a then small and somewhat isolated town about 120 km south west of Helsinki. Campbell, accepting that the relation between syphilis and GPI had been proved to be close, concluded with a forceful repetition of his 1893 thesis that the pathological changes in GPI had a toxæmic basis.\textsuperscript{14}

In mid-1893, Campbell turned to the signs of disease among what were then termed ‘the aged insane.’ Just what conditions were included under this head is not now clear but it is likely that it covered relatively uncomplicated cases of dementia. Bevan Lewis from the West Riding Asylum, whose work Campbell particularly admired, had noted that while Senile Dementia was marked by the steady decline of all mental faculties, and was the most numerous kind of dementia, other conditions

\begin{itemize}
\item \textsuperscript{13} A. W. Campbell, ‘A contribution to the morbid anatomy and pathology of the neuro-muscular changes in general paralysis of the insane’, J. Ment. Sci., 40 (1894) 177-195 (2 Plates) [at 188, 192].
\end{itemize}
such as Senile Mania, Senile Melancholia, Chronic Cerebral Atrophy, and Senile Convulsions had also to be encompassed.\footnote{W. B. Lewis, \textit{A Text-Book of Mental Disease with Special Reference to the Pathological Aspects of Insanity} (London, Churchill, 1889), pp 405-409.}

Campbell studied all the patients over 60 years of age who had died in Rainhill since he had been appointed pathologist: 22 male and 28 female patients averaging in age 67.6 and 70.5 years respectively. Naked eye examination showed a number of changes similar to those in GPI (e.g. subdural hematomata) but a number were not (e.g. atrophy of the white matter proportional to the surface atrophy, and brown coloured sclerosed remnants of perivascular haemorrhages). The frontal lobes, the cerebellum, and mesencephalon were wasted or atrophied. Microscopically some peripheral nerves showed parenchymatous degeneration but the most striking change was the great reduction in the number of fibres and their replacement by debris, by fibrous cellular material, and by collections of minute nerve fibres that possessed a distinct axis-cylinder but only a thin and delicate medullated sheath.

Campbell found an abundance of Deiter’s cells in the first layer of the cortex and noted that granules of a golden pigment were entangled in their processes or had replaced their centres. The cells had a quite different appearance from those in GPI and Alcoholic Insanity. He regarded the pigmentation as one of the most constant features in cases of insanity in the aged, and noted that it had been given little previous attention. In bringing the pathology of the changes together, Campbell made five points. First the Deiter cells were different in the aged insane from those found in GPI; there were no changes in pigmentation in GPI; when symptoms and macroscopic changes resembling GPI were present, they were typical of senescence; the neuro-vascular changes found in the cord in Parkinson’s Disease were also found in the cord of the aged insane and could not be specific to it; and the fine longitudinal fibres in the diseased nerve bundles in the spine might be part of a process of regeneration. If so, they might account for the ‘intention tremors’ seen in both senescence and GPI.\footnote{A. W. Campbell, ‘The morbid changes in the cerebro-spinal nervous system of the aged insane,’ \textit{J. Ment. Sci.}, 40 (1894), 638-649.}

Campbell himself drew no overall conclusion from this work and after its completion seems never again to have commented on it, giving only its title in the list of his works he prepared toward the end of his life. Others were more appreciative. Ireland in 1898 devoted about 5 of his 14 page ‘German retrospect’ to what Alzheimer, Schmidt, and Redlich had reported separately that year on senility. He drew particular attention to the fact ‘that both Schmidt and Alzheimer frequently quote from Dr.
Campbell’s valuable paper.\textsuperscript{17} When dementia began to be discussed more frequently in the 1960s and 1970s, Campbell’s findings were once again endorsed.

In 1895 Campbell published a study on what to us now seems the bizarre topic of the breaking strain of the ribs of asylum patients. In 1893 Charles Arthur Mercier (1852-1919), a well-known alienist who went on to become the President of the Medico-Psychological Association in 1908-1909, asked asylum medical officers in every asylum in Britain to establish objectively, with an instrument of his own devising, the force needed to fracture the ribs of the insane. He made this request because when the ribs of asylum patients were broken during physical assault either by asylum attendants or other patients, suspects were frequently defended with the argument that the ribs of the ‘insane’ were weak as a consequence of a general weakness that affected every organ and system of the mentally ill (e.g. Old Bailey Proceedings, 1860; British Medical Journal Editorial Note, 1860).

Campbell was the sole asylum doctor to take up Mercier’s request and did so in a way novel in late 19th Century medicine: he compared the averages of the force required to break the ribs obtained from the bodies of deceased male and female asylum patients with those from the bodies of non-patients matched for age and sex. There was no essential difference. Campbell also made a thorough histopathological examination of the ribs themselves, identifying exactly the age-related changes that had made them so fragile.\textsuperscript{18}

This thesis of a generalised weakness among asylum patients was taken up by Campbell again some five years later in a study of colitis which, in the world of mental illness, was most frequently called ‘asylum dysentery.’ Germ theory, founded on the work of Koch and Pasteur, was still then relatively new, and its central thesis that disease was transmitted by micro-organisms was not widely accepted despite Koch’s demonstrations in the late 1870s. Outbreaks of dysentery were common in asylums and, in the absence of any accepted causal agent, were mostly attributed to various vague agents, like miasma, or to weakness in the patient. Campbell seems to have been an early convert to germ theory and armed with his Prague course in ‘Sanitary Science’ and the help of Rubert Boyce, the Professor of Pathology at Liverpool University, and one of the pioneers of bacteriology in Britain, set about trying to identify the bacterium responsible for it.

\textsuperscript{17} W. W. Ireland, ‘German Retrospect’. \textit{J. Ment. Sci.}, 44 (1898) 860-874.
In two important papers published in 1898 and 1899, Campbell clarified what was meant by the terms dysentery and colitis, presented statistics, and asked if there was a relation between colitis and other diseases. He found none with mental disease and only a slight indication of one with kidney disease. What brought susceptibility to colitis was general debility. In the longer 1899 paper he reported that while there was no distinct evidence of contagion, the prevalence at Rainhill had declined since cases were quickly isolated, materials disinfected or destroyed, and ‘free lavage of the large bowel with copious injections of bactericidal enemata.’

After analysing previous work, Campbell came to feel that bacterial infection was a more likely cause than amoebic infection or mechanical or toxic agents. He examined faeces, blood, and tissues for micro-organisms and tested the pathogenicity of cultures from this material on animals. He found no amoebic coli but injections of a pure culture of a bacterium that was always present caused colitis-like symptoms and usually death when injected into rabbits and guinea pigs. The organism was always recovered from the animals’ blood and from cultures of faecal material from patients. The latter produced positive results when fed to rabbits. The single pig used was insusceptible.

Of the bacterium itself, Campbell wrote in 1899 that it was a short stout flagellated bacillus with rounded ends. It stained well with aniline dyes, but was partially decolourised by Gram’s method. It grew freely on agar and somewhat slower on potato, where it formed copious coloured growths, of equal depth and with an even margin; it did not liquefy gelatine; iodide of potassium impeded but did not altogether check its growth; it formed gas freely, it coagulated milk, and it generated indol. He took it to be a strain of \( B. \) \( coli \) (sic) and interpreted its non-clumping in human serum as an indication of its virulence.

Campbell would not say his work ‘settled the question of the bacterial origin of asylum colitis’ definitely but only that the form of dysentery met with in asylums was ‘in the highest probability of bacterial origin’ and that ‘the micro-organism standing in the closest causal relationship to the disease is the one I have described as a short, stout, rod-shaped bacillus …. really indistinguishable from the \( B. \) \( coli \) communis.’ Campbell’s caution was warranted because he was wrong. By 1897 Kiyoshi Shiga had discovered the causal micro-organism known later as \( Shigella \) \( dysenteriae \). Nevertheless, Campbell’s error is understandable: some strains of \( Escherichia coli \), as \( B. \) \( coli \) is now

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19 A. W. Campbell. ‘Colitis’. \( J. \) \( Ment. \) \( Sci. \), 44 (1898) 526-531; A. W. Campbell, ‘Colitis or dysentery; an etiological and anatomical study’. \( J. \) \( Path. \) \( Bact. \), 6, (1899) 227-272, (2 Plates) [at 238, 261, 262, 264].
known, are so closely related to *S. dysenteriae* that they are very difficult to differentiate. The main difference is that shigellae are Gram negative and not flagellated.

While at Rainhill, Campbell also reported a number of purely clinical cases, none of which involved mental illness proper, and included the effects cerebral thrombosis, the effects of pernicious anaemia on the spine, and the symptoms characterising the conditions now known as the agnosias. In all these *clinical* reports he went to some trouble to link the symptoms to the pathological changes found *post-mortem*. From about 1894 he added the investigation of standard neurological structures, most notably in tracing the effects of lesions on tracts from the cerebellum and on tracing the spinal tracts directly using the relatively new Marchi method.

Let me now jump to the last work Campbell completed at Rainhill, that in 1905 on cerebral sclerosis, even though discussing it here disrupts my chronological sequence (Figure 1). In this 71-page profusely illustrated paper in the ‘Original Articles and Clinical Cases’ section of *Brain*, Campbell drew on his own case material and that of others to bring together descriptions of the pathology of seven relatively rare conditions in which there was a hardening of tissue of the brain, rather than that of the brain’s arteries. Although comparisons are difficult because of name changes, what Campbell found stands up rather well.

The introductory part of Campbell’s paper began with two questions. First, where in the brain tissue did the hardening begin? Was it in the glia, the neurones, or the nerve fibres themselves? Second, was the sclerosis a proliferation and hyperplasia of pre-existing elements or did it grow from new elements? Campbell came to the conclusion that it was in the glia and that its nature varied from one type to another. Perhaps the most significant of his examinations and the easiest to compare with contemporary work was that of tuberose sclerosis. He drew attention to four features. First were the acinoid or berry-like structures in the tuberose masses. He was the first to recognise them. Second were the giant or ganglionic nerve cells that resembled motor cells. They had been noted by only three others. Third were the growths in the ventricles and kidneys. Finally there were the components of the cutaneous deposits. Campbell argued that this complex of changes was

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all part of a single condition that reflected an alteration in the rate of growth of the cells (hyperplasia) and the places where they grew (heterotopism).

With prescient touch, Campbell surmised ‘that the activity of the germinal elements giving rise to the growths has been deferred by some error in development, and that they have continued to grow in a spurious and abortive fashion long after their appointed term and metamorphosis’ (emphasis added). Tuberose sclerosis is now known to be caused by the failure of one or both of two genes responsible for suppressing tumour growth. The remainder of Campbell’s notion that the condition was a developmental aberration or disturbance arising during the last few months of foetal life may not be very specific but it is not inconsistent with modern knowledge.

Perhaps of equal significance was Campbell’s identification of the triad of features of intellectual deficit (‘idiocy’ or ‘imbecility’), idiopathic convulsions, and adenoma sebaceum. The three, he concluded, ‘may lead to a diagnosis of the disease during life.’ This identification is a rarely recognised aspect of Campbell’s work. Most frequently the German neurologist Heinrich Vogt (1875–1936) is credited with the triad (1908). True, it did become known gradually that neither epilepsy nor profound intellectual handicap need be present, but the originality of Campbell’s identification of the triad is overlooked entirely, as, for example, in Tredgold’s 1914 influential book on ‘mental retardation,’ in Critchley’s and Earle’s 1930s equally influential and reputedly comprehensive review of the condition, in Robertson’s single (and incorrect) reference to him at the 1990 meeting of the New York Academy of Sciences (published the following year by Johnson and Gómez), and more recently in the 2004 special issue of the Journal of Neurology devoted to the condition.22

And so we come to Campbell’s greatest achievement - his pioneering histological differentiation of the structures in the cortex of the brain that supported its various functions. The whole of this work was conducted at Rainhill between 1901 and 1904, almost all of it before the Rainhill Pathological Laboratory was opened.

Campbell knew Charles Scott Sherrington (1857–1952) and Albert Sidney Frankau Grünbaum (1869–1921) as fellow members of the Liverpool Medical Institution and had served with Sherrington on its Pathology and Microscopical Committee. He also knew that at the University of Liverpool the pair had used electrical stimulation of the

exposed cortex of chimpanzee, orang-utan, and gorilla to establish the motor area of the brains of these animals. In 1937 he recalled:

Thinking that this area must have special histological features I asked for and was given the cerebral hemisphere of a chimpanzee which had been removed and experimented upon. Taking this away and examining it in my own laboratory I was able to prove that by histological means an area could be defined which scarcely varied one hair’s breadth from the ‘motor’ area defined by unipolar faradisation, the method used by Sherrington.\(^{23}\)

Sherrington appears to have been impressed, remarking later that ‘It had been a great pleasure to them to find that Dr. A. W. Campbell, by a laborious investigation of the microscopical character of the cerebral cortex, had shown that the boundaries of the ‘motor’ area as defined by anatomical characteristics accorded with those already obtained by them with physiological methods.’\(^{24}\) From Campbell’s reports of the species he examined in the next 2 years, it is clear that Sherrington continued to supply him with chimpanzee and anthropoid brains.

In the next 3-4 years, Campbell completed an enormous amount of this kind of work which can be summed up briefly as a systematic investigation of the fibres and cells making up the different structures of the cerebral cortex in humans and animals. I use the word ‘enormous’ to point to the fact that each human hemisphere took about six months to examine completely and Campbell examined eight normal human brains completely (three for fibres and cells, three for fibres only, and two partly for fibres and cells), and parts of 15 additional brains of patients with disease, amputation, and blindness that were likely to be affected by the loss of function. In addition there were the animal brains.

Campbell’s method was first to fix the brains in formalin, cut them into blocks at right angles to the main sulci to give transverse views of the principal gyri, and then stain preparations of the blocks cut at intervals of 1 mm with a Jung microtome. Staining of the 25μ or 15μ thick sections so prepared was with the Wolters-Kulchitsky method which, although he found tedious, gave, he thought, the most faithful display of the fibrils, the sharpest delineation of the larger fibres, and the deepest colouring of the myelin. Campbell used Thionin 0.25% for the cells so that, in spite of

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the thickness of the sections, the Nissl bodies, the cell morphology and lamination were all shown perfectly. An apparently unique feature of his sectioning was that it allowed adjacent sections of fibres and cell laminations to be compared.

We know that Campbell’s work was done in two parts: he began, probably in 1901, by staining only for fibres but from about 1902 he stained for cells as well. His first paper considered only fibres and then only in relation to what his then colleague Joseph Shaw Bolton (1867-1946) had localised histologically as the visual area and to what Sherrington and Grünbaum had established as the motor area. He eventually distinguished some 14 areas of the brain, depending on how one counted, and related them to their functions, when they were known. The relation was clearest with the visual, auditory, and motor cortices. From 1902 on he conveyed his findings to physiologists and neurologists interested in vision, audition, and movement (Figure 2). Sherrington communicated his complete human, chimpanzee and anthropoid findings to the Royal Society of London at the end of 1903, and added those from cat, dog, and pig a year later.25

Campbell’s first reports to the Royal Society appeared as abstracts in its Proceedings. As was customary, two Society Referees, Frederick Walker Mott (1853-1926), the English neuropathologist and psychiatrist, and William Maddock Bayliss (1860–1924), the English physiologist, were then appointed to judge whether the work was worthy of publication in the Society’s Transactions. Both thought it was although both thought it was too long for that vehicle. Bayliss opined that the Society could ‘do a real service to science’ by its publication and to do so would ‘conduce to the honour’ of the Society. Note that Bayliss felt the honour would accrue to the Society rather than to Campbell. There was still the problem of length. The Society agreed to subsidise publication of a shortened version as a book - Campbell agreed - and Sherrington, it is

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said, negotiated on behalf of the Society for Cambridge University Press to publish it.\textsuperscript{26}

The reviews of *Histological Studies* were generally favourable, although some British reaction was muted. Non-English appreciations were always extremely positive, the most powerful being in a letter from Rafael Lorente de Nó (1902-1990) to John Farquhar Fulton (1899-1960), the eminent American physiologist, accompanying his draft of the first three sections of a chapter on the cerebral cortex for Fulton’s 1938 *Physiology of the Nervous System*. In pleading for figures to be included, Lorente de Nó went on:

> The only good ones are those of Campbell, who, let me put it in capital letters, HAS BEEN THE ONLY CYTOARCHITECTONIST WHO HAS DESCRIBED FACTS AND ONLY FACTS. The German architectonists have mixed facts with theories in such a manner that nobody can tell where facts end and theories begin. I must state that there is perhaps no more than a dozen photographs in which the layers of the cortex have been properly and consistently labeled. On the other hand, Campbell’s ink drawings, besides being good, are easily reproduced.

Fulton obliged. He included the figures in his text and Lorente de Nó’s judgement in his obituaries of Campbell.\textsuperscript{27}

Despite the vicious attacks on Campbell’s work by Victor Horsley (1857-1916), Gordon Holmes (1876-1965) and Page May, attacks really directed against Sherrington for promoting the concept of a motor cortex rather than a sensory-motor cortex, and which formed part of Horsley’s personal vendetta, it was Campbell who won out. All the histological work he did at Rainhill was extremely well-received and contributed considerably to Rainhill’s research status. But, among that work, it was his pioneering studies of the human brain that contributed most. Almost immediately he was recognised as the world authority on the minute structure of the brain, and was so regarded well before Korbinian Brodmann (1868-1918).

Figure 1. Alfred Walter Campbell. Copy of an undated but pre-1906 photograph presented by Campbell on 14 March 1906 to the NSW Medical Board as part of the conditions then required for the registration of medical practitioners. Courtesy of Norm Ricaud, Reprographics Officer, State Records Authority of New South Wales.
Figure 2. Campbell’s brain mappings: (a) fibre only, 1902, (b) and (c) fibre and cell, 1904 and 1905

(b) From unnumbered figures opposite pages 658 and 659 of A. W. Campbell, ‘Histological studies on the localisation of cerebral function,’ *J. Ment. Sci.*, 50 (1904), 651-662.

Coming to the end

About three weeks after passing the last page of *Histological Studies* for proof and two after his last post-mortem examination at Rainhill, Alfred Walter returned to Australia. Why then?

Emeritus Professor Mervyn Eadie, the historian of Australian neurology, believes Campbell returned to marry his childhood friend Walterina Jane (Jean or Jeannie) Mackay. Given his minuscule Rainhill salary he would have needed something like a professorial income to support a family. Jeannie visited England in 1901 and later that year Alfred Walter applied for the Foundation Chair of Pathology at the Sydney University. He was the favoured and most highly qualified candidate but was quite unexpectedly not successful. By the time of the decision in late 1901, his failure and his beginning work on the structure of the brain may well have tied him to England. Something similar happened in 1904 when he did not obtain the position of Inspector
General of the Insane in Victoria. When that decision was made he was in the throes of condensing and editing his *Histological Studies*. Return was then again not possible but leaving after completion was.

On either 3 or 4 November 1905 Alfred Walter Campbell departed on R.M.S *Orotava* which reached Sydney on 15 December. He moved quickly to establish his practice and begin family life. On 14 March 1906 he registered as a Medical Practitioner with the NSW Medical Registration Board and began his career as Australia’s first neurologist. About ten weeks later, on 30 May 1906, he married Jeannie Mackay.

We know little about Campbell’s setting himself up in neurological practice. Only one of his Rainhill papers had been noticed in the Australian medical press but he presented his histological work on the motor cortex, on amnesia, and the cerebellum at medical meetings in 1906, 1907, and 1911. He also published a number of clinical papers and regularly attended meetings of the NSW Branch of the BMA. In his earliest Australian publication, of 1910, Campbell described in great detail the treatment of trigeminal neuralgia with injections of alcohol. He had learned the procedure in Paris directly from its founder, François Ostwalt (1862-1937). Campbell warned because there was no long term follow-up data the connection between the ends of the alcohol-destroyed nerve might be re-established, as proved to be the case. His 1913 demonstration of a case of the rare condition of syringomyelia in which the loss of sensation was unusually confined in the lower rather than the upper part of the body may also have helped him to become better-known.²⁸

Whilst establishing his practice, Campbell managed to continue histological research, probably funding it himself. His comparative study of the cortex of the cerebellum disproved the 1906 claim by Louis Bolk of a positive correlation between the size of parts of the cortex of the cerebellum and the size of various muscle groups of various animals.²⁹

Two factors that should not be overlooked in Campbell’s establishing himself in Sydney’s medical and social circles are residence and golf. By 1911 he and Jeannie had moved with their daughters into a house designed by his architect-brother in Rose Bay overlooking the southern shore toward the east of Sydney Harbour. The area, although fairly new, included among its inhabitants a number of medical


practitioners who lived near to Campbell, some of whom became his colleagues.

Golf, which Campbell does not seem to have played whilst in Scotland or England, became his sport and doctors seem to have constituted about 15% of the teams fielded in inter-club competition. As early as August 1906 he played at the Australian Golf Club, near to his temporary residence in Randwick, with R. J. (‘Roley’) Pope, his erstwhile Edinburgh-Australasian cricket captain. He then joined the Manly GC of which Pope had been a joint founder. Campbell soon became reasonably skilled; under the U.S. Metropolitan Golf Association’s handicapping system adopted in NSW he was on 5 by 1912.

In August 1914, World War I broke out. Campbell, a reservist with the rank of Captain, applied on 2 November 1914 for a commission in the Australian Army Medical Corps. He departed on 28 November 1914 to take up duty at 2 Australian General Hospital (2AGH) in Cairo, Egypt.\footnote{National Archives of Australia, Defence Record, B2455, Alfred Walter Campbell.} The main task of 2AGH came to be that of dealing with the causalities among the combined Australian and New Zealand (ANZAC) force that had been allotted the Gallipoli peninsula as part of the ill-fated Dardanelles campaign in which Australian battle and other casualties over the eight months were high: 8,709 killed in action, 17,924 wounded (2,012 of whom later died of wounds), and some 63,969 who became ill, at least 665 dying of disease. Many of the cases of neuroses and psychoses to which the severe conditions on Gallipoli gave rise found their way to Campbell’s wards in 2AGH. Campbell’s own service was relatively uneventful and he left Suez on 15 November 1915 when his period of service expired and arrived in Melbourne on 13 December.\footnote{National Archives of Australia, A. W. Campbell.}

Within months of returning, Campbell published his Cairo observations in one of the earliest and most perceptive papers on the neuroses and psychoses in war.\footnote{Retrieved from Australian War Memorial, Encyclopedia: Australian Fatalities at Gallipoli on 1 November 2012 at http://www.awm.gov.au/encyclopedia/gallipoli/fatalities and from Australian Government, Department of Veterans’ Affairs, The Gallipoli campaign at http://www.dva.gov.au/news_archive/Documents/The%20Gallipoli%20Campaign.pdf; A. G. Butler, The Australian Army Medical Services in the War of 1914-1918, Volume 3. (Canberra, Australian War Memorial, 1943) [at 82, 86-87, 88-89, n. 48, n. 52]; A. W. Campbell, ‘Remarks on some neuroses and psychoses in war’. Med. J. Aust., i (1916), 319-323.} He also began his second major piece of Australian histological research: the first cytoarchitectonic study of the brain of the gorilla. The brain, apparently sent by Sherrington, allowed him to expand on and modify his previous ape and human findings. It was used by Leyton and Sherrington in their first published gorilla research and Campbell’s own, obscurly published version, was not ‘discovered’ until thirty years later by Fulton who recognised its
uniqueness, and arranged for this ‘beautiful piece of work’ to appear in *Science*.

During 1918-1919, Campbell drew on his histological and bacteriological skills in making a very substantial contribution to the investigation of the mysterious Australian ‘X’ disease, later known as Murray Valley encephalitis. As Frank Macfarlane Burnet (1899–1985), the Australian Nobel Prize virologist and immunologist, said in reconsidering this work, ‘I think, therefore, that it is only just to claim for Cleland, Bradley, and Campbell the first recognition of a disease of the type we now call the insect-borne encephalitides and the first ‘isolation’ of one of the viruses responsible.’

Campbell also played an important but minor role in 1927 and 1928 by apparently confirming the effects of Hunter’s and Royle’s cervical ramisection procedure on animals. That work marks the end of Campbell’s Australian research.

The breadth of Campbell’s clinical knowledge and caution is seen in his publications on rare conditions with unusual features such as two then atypical cases of hereditary conditions. One was of Friedreich’s disease in an eight year-old girl, neither of whose parents were affected, but whose two other siblings were and the family history otherwise negative, and some physical symptoms were absent. The other was of Thomsen’s disease in a 27 year-old male with an early healthy history and late-onset but whose parents and two sisters and their children were unaffected.

This caution is often seen in longer formal addresses and papers, like his invited address on the labyrinth to the Section on Neurology and Psychiatry meeting of the BMA in November 1923, in which he doubted Bárány’s views of cerebellar control of muscle tonus,

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and his April 1924 address on Head’s then very new tests for the analysis of verbal aphasia. His many summary papers are similar.

**Stopping**

Alfred Walter Campbell died of prostate cancer at his home in Rose Bay on 4 November 1937. He was 69. In paying the earliest of the tributes to him, Leslie Richard Parker began by drawing attention to his reputation extending throughout the medical world. He then singled out *Histological Studies*, now 30 years old, as the accepted authority. Because it was such a landmark, William Dawson (1938) said Alfred Walter’s name would endure but he nevertheless also highly praised Campbell’s work with Head on the dermatomes, his critical digest on spinal tract degeneration, and the outstanding tribute to Hughlings Jackson he had astonishingly delivered without reference to notes. Were they not matched by other non-Australian appreciations these judgments could be disregarded as being magnified by local Australian pride. There is any number of appreciations, especially by non-English citizens, who endorsed and continue to endorse Campbell’s achievements.

Almost everyone who spoke or wrote about Campbell’s personal characteristics mentioned three things about him. First was his command of language, the care with which he used it, and his facility in German, French, and Italian. Combined with the logic of his clear and precise thinking, this command made him a brilliant didactic speaker. Second was his modesty. Some reviewers of *Histological Studies* sensed this and Parker illustrated the same point by recalling that Campbell replied to a question about what he had done in England - the questioner meant when he was a medical student - by saying that when he was not playing cricket he was shooting grouse. Campbell’s third characteristic was his tenacity, most of all in what Fulton called the almost incredible task of sectioning, staining, and examining the brains he used in *Histological Studies*, and also in preparing the material for publication. It is also clear in the thoroughness of his investigation of colitis and the dermatomes.

That Alfred Walter Campbell is now an almost forgotten figure is sad. Equally sad, perhaps even more so, is that the Rainhill that had once been such a centre for research of international significance is now only a memory.

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