Henry Molaison on his graduation day.

NEUROSCIENCE

Losing the past

Douwe Draaisma visits the unusual mind of Henry Molaison, the most famous patient in brain science.

On 2 December 2008, Henry Molaison died. He was 82 and had been living in a nursing home in Windsor Locks, Connecticut. After Suzanne Corkin, a neuroscientist at the Massachusetts Institute of Technology in Cambridge, issued a press release about his death, it became clear that Molaison was the elusive 'HM' — arguably the most famous patient in brain science.

HM's fame hinged on a calamity. His first life had ended long before, in 1953, when a surgeon's knife left a devastating loss of memory in its wake. The nature of his lesion and its consequences launched HM on a distinguished career as a subject of many key neuropsychological experiments. Corkin, who worked with HM for half a century,

has now written *Permanent Present Tense*. She has woven her memories of her experimental and personal dealings with HM into a panoramic history of the past 60 years of the neuropsychology of memory. The result is superb. Because she was such an integral part of this history, *Permanent Present Tense* is also her intellectual autobiography.

Molaison was just 27 when he underwent the devastating surgery to treat his intractable epilepsy. His operation was "frankly experimental", as his surgeon, William Scoville, put it. The amygdala and a large part of the hippocampus were removed from both sides of Molaison's brain. Textbook versions of HM's story often feature 'a daring surgeon', but some feel that a bilateral resection

Permanent Present Tense: The Unforgettable Life of the Amnesic Patient, H.M.

SUZANNE CORKIN
Basic Books: 2013.
400 pp. \$28.99

was an irresponsible act, even if it was common practice in the rough field of lobotomy. The surgery brought Molaison partial relief from seizures, but expunged most of his memories and left him unable to store new information. From then on, HM was frozen in the titular 'permanent present tense'.

Corkin first met HM in 1962, and studied him for her PhD thesis in Brenda Milner's lab at the Montreal Neurological Institute in Canada. After Corkin's long collaboration with HM, she was still only a vaguely familiar face to him. She acted both as a researcher and a gatekeeper, carefully scrutinizing fellow scientists and their research plans before allowing access to this precious test subject. Unlike Alzheimer's disease, which causes global neurological damage, HM's lesion was rather specific. And so, it seemed, was the nature of his amnesia. Yet some of the momentous episodes in his 'career' as a study subject were associated with findings that complicated the initial image of simple anterograde amnesia.

To begin with, work with HM offered experimental proof of the distinction between short-term and long-term memory. HM could store information — such as a sentence — for about 10 or 20 seconds. Once he stopped thinking about it, there was no way it could re-enter his short-term memory. Apparently, the hippocampus is essential for moving information from short-term to long-term memory, but not the other way round. Some of his spared older memories could pop up in his mind and prompt him to tell an anecdote from his youth, even if he was unable to remember that he had told the same story 10 minutes ago.

In 1962, however, Milner demonstrated with HM that some types of information did make their way into long-term memory. After three daily sessions during a week's training on a visuomotor task — tracing a star shape while looking in a mirror — HM's performance improved considerably. He forgot both lessons and teacher, but remembered what he had learned. Preserved learning was confirmed in other types of tasks, and contributed much to the distinction between

nondeclarative (or implicit) and declarative memory. To most of us, knowing that one has learned something and remembering ▶

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A retrospective look
at Jorge Luis Borges
and memory:
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▶ what one has learned seem to be the same thing. HM showed that these are in fact two separate types of memory.

Further work with HM also forced Corkin to reconsider the initial idea that his operation had effectively cut his memory into two neatly separated temporal compartments. This was true for his vocabulary: his world remained one of rocketeers, never of astronauts. But when Corkin asked HM in 1966 to draw the floor plan of the house he had moved into five years after his operation, he produced an accurate plan from memory. When he moved house, however, HM would get lost and show up at the doorstep of his former home.

Several details on HM's personal life were already available in 1995, when science writer Philip J. Hilts published his compelling book *Memory's Ghost* (Touchstone, 1996). Where Hilts and Corkin seem to diverge is in their appreciation of Scoville's operation. Corkin does sketch Scoville's questionable background in lobotomy, but is somewhat apologetic on the bilateral resection. Hilts is considerably more critical, mentioning that Montreal neurosurgeon Wilder Penfield "exploded into the telephone" when Scoville called him with the details of HM's surgery. Ironically, the Scoville and Milner 1957 paper, 'Loss of Recent Memory after Bilateral Hippocampal Lesions', became a citation classic and the operation on HM developed into Scoville's claim to fame.

In 2002, Corkin announced that HM had agreed to donate his brain to science. She decided that Jacopo Annese, head of the Brain Observatory at the University of California, San Diego, was the person for the job. HM's brain even raised funding after his death: for US\$50, visitors to the Brain Observatory site could sponsor one of the 2,401 slide-mounted sections into which it had been sliced.

The exact locations of the lesions that caused HM's amnesia were ascertained by high-resolution magnetic resonance imaging scans, made a few hours after his death. HM's virtual brain will probably take its place among relics of neurology such as the skull and iron rod of Phineas Gage and the brain of the speechless Monsieur Tan, neurologist Paul Broca's patient. Whether it will serve as an opportunity for future research remains to be seen, but HM will live on in other ways. The rights to make a film about his life have been sold to Columbia Pictures and Scott Rudin, who in 2007 produced *No Country for Old Men*. ■

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An artist's impression of a future mission to the red planet.

SPACE EXPLORATION

Life on Mars

Jim Bell welcomes a detailed blueprint for colonizing the red planet from *Apollo 11* veteran Buzz Aldrin.

For many, our exploration of the cosmos seems to hinge on grand and singular theoretical observations and technological achievements such as those of Galileo and Einstein. We are fascinated by paradigm-shifting discoveries and personal stories — the oppressed astronomer, the quirky professor. Yet in the arena of global science and engineering, it often takes the less flashy, more mundane development of good policy and follow-on infrastructure to maintain and sustain those changes, and to enable even more discoveries.

In *Mission to Mars*, celestial-mechanics expert and *Apollo 11* astronaut Edwin ('Buzz') Aldrin, with space journalist Leonard David, argues that achieving the next great singular goal in space exploration — a sustained campaign to explore and ultimately settle Mars — will require a healthy dose of such pragmatism. The United States will, they say, need both significant advances in its space transport infrastructure and considerable changes in space policy.

Ever since his historic 1969 lunar-landing mission, Aldrin has been a passionate and outspoken advocate for continued US leadership in space exploration. Calling the space shuttle programme "bad judgment" because it placed humans and cargo together, and a second race to the Moon "a

Mission to Mars:
My Vision for
Space Exploration
BUZZ ALDRIN
National Geographic
Society: 2013. 272 pp.
\$26 (£17.99)

dead end" in terms of either a commercial or a scientific pay-off, here Aldrin plants his flag in the middle of NASA's ongoing identity crisis about the future of crewed space missions. He draws a line in the exosphere, defining low-Earth orbit and even the Moon as the realm of private enterprise and commercial space development. He goes

on to write that "America's space program should help other nations achieve what we have already done", and echoes the controversial call to bring both China and India in as International Space Station partners.

These and other recommendations from one of America's first moonwalkers make *Mission to Mars* more than just a plea for exploration of the red planet. Aldrin outlines what he calls his "Unified Space Vision", which he believes is needed to enable humanity to establish permanent settlements beyond Earth. Some of its crucial elements would be an independent think tank to advise government, industry and the public on space issues,

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