the evolution of magnetic fields. In this regard, there is evidence that the progenitor of at least one magnetar was extremely massive[6], and it has been suggested that the progenitor of PSR J1846-0258 was a (massive) Wolf–Rayet star[7]. Thus, pulsars with similar *B* may have substantially different actual fields, which could have resulted in part from different initial conditions, including spin rates (a key ingredient in the generation of the huge magnetic energies associated with magnetars is the efficient conversion of differential rotation during core collapse[8]).

Youth is presumably also relevant. Although we lack a self-consistent understanding for the thermo-magnetic evolution of strongly magnetized neutron stars[9], different temperatures and possibly different sub-surface field geometries could lead to different incidences of magnetar behaviour among stars with similar inferred (or actual) *B*. Age is difficult to determine, but it seems that PSR J1846-0258 is substantially younger than most ordinary pulsars with larger B.

Finally, selection effects should not be discounted: the identification of PSR J1846-0258 as a part-time magnetar relied on full-time X-ray monitoring, which is not feasible for most rotation-powered high-*B* pulsars. Nevertheless, magnetar activity among these neutron stars could be inferred from abnormal rotational behaviour detected from radio-timing observations. Recent observations conclusively link magnetars with rotation-powered pulsars[1,2,10]. This newly appreciated connection provides an opportunity for fresh insights into fundamental questions in neutron-star physics and magnetism.

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JOHN WHEELER

Three ages of man

"Time", John Archibald Wheeler once said, "is what prevents everything happening at once." Of eclectic interests and boundless enthusiasm — he was wont to write lectures on the blackboard simultaneously with both hands — Wheeler often seemed intent on subverting that dictum.

Born in Jacksonville, Florida, on 9 July 1911, Wheeler received a doctorate on the dispersion and absorption properties of helium from Johns Hopkins University, Baltimore, at the age of just 21. Hearing Niels Bohr speak at the Chicago World's Fair the same year, he applied for a postdoctoral fellowship to study under him in Copenhagen.

Thus began what Wheeler called the first of three stages of his scientific life: the "everything is particles" phase. In 1937, back in the United States, he introduced the S-matrix formalism, a tool still used to calculate final from initial states in particle interactions. When his mentor Bohr visited New York in 1939, Wheeler met him off his ship and heard the first news of Otto Hahn and Fritz Strassmann's discovery of nuclear fission. The two immediately set to work on the underlying theory, developing the nuclear liquid-drop model.

Inevitably, Wheeler was, in 1942, seconded to the Manhattan project. An American among aliens, Wheeler did not share the fears of many of the European refugees working on the bomb. But his conviction in its rectitude as a means to save lives had equally personal roots. He often recalled how his younger brother Joe,

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who fell during the Allied advance in Italy in 1944, signed off his last letter: "Hurry up, John".

After the war, Wheeler went to Princeton and embarked on his second age: "everything is fields". He collaborated closely with Albert Einstein, and developed a theory he called geometrodynamics, in which he sought to reduce all physical phenomena to consequences of the geometry of spacetime. It proved a dead-end, but its legacy was to place general relativity firmly at the centre of physics.

Wheeler's students during this period included Richard Feynman and Hugh Everett III, whose doctoral thesis introduced the 'many worlds' interpretation of quantum mechanics. Like many others, both men benefited from Wheeler's extraordinary gifts as a teacher and communicator. A lover of poetry and philosophy, Wheeler was acutely aware of the power of words to shape ideas. That percipience was most evident in his coining the term 'black hole': it was, he said, "an act of desperation", intended to force people to believe in the idea.

As he moved into his third age ("everything is information"), Wheeler grappled with the origin of physical reality — a line of thought he summed up as "every it is a bit" — and sought ceaselessly for an answer to his mantra, "How come the quantum? How come existence?" Those deliberations came together in his championing of the 'participatory anthropic principle': the belief, rooted in a logical reduction of quantum mechanics, that the Universe cannot even exist unless we as observers are there to see it.

Some of his contemporaries dismissed that as an old man's waywardness. In truth, it was the product of a still acute, iconoclastic mind. In Feynman's words, "Some people think Wheeler's gotten crazy in his later years; but he's always been crazy." Time, inevitably, did finally catch up on that mercurial intelligence. Perhaps the last survivor of physics' 'age of heroes', Wheeler died on 13 April, aged 96.

Richard Webb