

Tribute

Death of a Physicist ***Stephen Hawking 1942 - 2018***

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Stephen William Hawking, physicist, born January 8, 1942, died on March 14, 2018, aged 76. By the time he was 21 he was diagnosed to be suffering from an unspecified incurable disease, later identified as the fatal degenerative motor neurone disease amyotrophic lateral sclerosis, or ALS. Instead of succumbing to depression he focused on looking into the universe and raising fundamental questions about the nature of the universe. Defying he lived, and what a life it was!



There are at least three Hawkings: the first rate physicist, the heroic patient and the husband. I am wary of prefixing an adjective to the last.

The world knows him for his intellectual breakthroughs. After a relative lull from 1920s, General Relativity had a tumultuous revival in the 1960s, and how! Hawking's demise, his moving on to the stars, is also a time to celebrate this revival along with Penrose and Wheeler, and other wonderful minds who have enlarged beyond measure our event horizons

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in space time. Some names: Bardeen, Bekenstein, Braginsky, Brandon Carter, Chandrasekhar, Geroch, Hartle, Raychaudhuri, Werner Israel, Misner, Oppenheimer, Thorne, Zel'dovich – one can add at least another dozen names without fear of sticking one's neck out.

The death of Hawking is, of course, a reminder, in more than one way, of the triumph of mind over matter – the sheer power of human will to survive a physical constraint, where many other mortals, would have thrown in the towel. What nurtured him and made his life more than bearable is old fashioned tender loving care of his first wife Jane, and of course the seduction of theoretical physics.

Genius and motorneuron disease featured prominently in the Hawking family's life – were it not for these two factors, the Hawking family saga would have been that of another white middleclass English family, “quite ordinary, quite common to most people's lives”.¹ Amyotrophic lateral sclerosis (ALS), also known as motor neurone disease (MND), and Lou Gehrig's disease, is a disease where nerve cells breakdown thereby making the related muscles less functional. Like most incurable (as of now) diseases, and especially like most neuromotor afflictions, it is a disease that needs to be managed till there is a medical breakthrough. Care givers of motor neuron disease, like any other incurable disease, know the frustration, the darkness and the utter misery of giving care. Often it is a one way traffic. There is no theory of everything in medicine. In Hawking's case, the gift of a sparkling mind that could explore the universe from the beginning of time, helped not a little in the management of the disease.

“In the early days our arguments on the topics rehearsed above were playful and fairly light-hearted. Increasingly in later years, they became more personal, divisive and hurtful. The damaging schism between religion and science seemed to have extended its reach into our very lives: Stephen would adamantly assert the blunt positivist stance which I found too depressing and too limiting to my view of the world, because I fervently needed to believe that there was more to life than the bald facts of the laws of physics and the day-to-day struggle for survival.”

— Jane Hawking, *Travelling to Infinity: My Life with Stephen*

The demise of Stephen Hawking, is, in at least one another way, the reminder of a triumph of mind over matter. It is why ‘armchair’ research should, combined with differential equations and intuition, and reasoning of a kind, should be so powerful in predicting about

¹ Jane Hawking in Postlude, February 2007 in *Travelling to Infinity: My Life with Stephen*.

our brick and mortar world. A question captured admirably by Wigner in the beginning of his classic essay²: "It is important to point out that the mathematical formulation of the physicist's often crude experience leads in an uncanny number of cases to an amazingly accurate description of a large class of phenomena". In the case of Hawking and the focus of his quests, it also begs the question how the primordial singularity can think about itself. If the universe were different, will our mathematics be different and will it still remain unreasonably effective?

Among other things, Hawking is famous for his role in confirming - along with Wheeler, Carter, Israel and Robinson - that a black hole has no hair, that is, a black hole can be completely described by the properties of mass, electrical charge and rotation; in the formulation of the four laws of black hole mechanics (with Bardeen and Carter) that was improved along thermodynamic lines by Bekenstein; that quantum mechanical considerations makes black holes evaporate; that black holes emit (Hawking) radiation; the big bang at the beginning of the universe also could have led to small black holes, etc.

A heavy mass – say of a dense star – collapses because of its own mass, in an infinitesimal space resulting in infinite density and gravity where space-time curves infinitely – and results in what we call a singularity. Our known descriptions of space-time fail in the presence of a singularity. What is a singularity? Salvation, and explanation, lies – we are told – by merging quantum mechanics and relativistic gravitational theories, but the jury is out and likely to be for some time.

A black hole eats up matter and energy, and light signals. The singularity at the center of a black hole can never communicate with anything outside as it is always surrounded by an area which does not allow light to escape. And then there are theories like loop quantum gravity (Ashtekar et al) which do not predict singularities at the big bang or in the centre of the black hole.

Needless to say these speculations raise new philosophical issues starting with the fact that under black hole conducive conditions our ideas of space, time, and causality need revisiting

²Wigner, E. P. (1960). "The unreasonable effectiveness of mathematics in the natural sciences." . *Communications on Pure and Applied Mathematics*. 13: 1–14.

including the Hawking idea that information sucked in by a black hole – well, is it really lost forever as the black hole is giving off radiation and finally nothing remains?

And Stephen... Remarkably Stephen has reasserted his control over his life. His second divorce is in its final stages, and since last summer he has been able to associate freely with us again, coming to family parties, gatherings, lunches and dinners either at our house or at Lucy's. It has been quite like old times, with plenty of banter and wit circulating round the dinner table while we wait for Stephen to have the last word, and I was delighted to be invited to the Royal Society to witness the presentation to him of the Copley medal, the oldest medal of the Society. As on so many previous occasions I was touched with pride at his achievement, though quite what his science consists of these days I cannot tell, apart from his much publicized recantation of some of his former theories. I must admit I was less happy with his expressed intention, announced on radio on the day of the presentation, of going into space...

...Since I finished writing the Postlude, Stephen has completed his zero-gravity flight and returned to earth intact, giving rise to triumphant pictures in the media. The smile on his face as he floated in weightless liberation would have moved the stars. It certainly moved me profoundly and made me reflect what a privilege it was to travel even a short distance with him on the way to infinity.”³

Stephen Hawking will continue to smile from his assured place beyond space-time.

³ Jane Hawking op. cit., in Postlude.