REMEMBRANCE OF STEPHEN HAWKING

Dinner after Funeral, Madingley Hall, Cambridge, 2018 March 31

Don Nelson Page

I am honoured to have been asked to give some recollections of Stephen.

I generally regard Stephen as the greatest expert on gravity since Einstein.

Many of you know Stephen's work better than I do, but let me just list a few of my favourites:

Stephen and Roger Penrose proved, assuming certain energy conditions and the observations that the universe is expanding, that according to classical general relativity, it must have had a singular beginning. Later, with Jim Hartle, Stephen made the no-boundary proposal for the quantum state of the universe, given by a path integral over complex histories with no singularities and no precise beginnings. He was also one of the first to show that if there is an inflaton, this or any similar quantum state in which inhomogeneous perturbations start in their ground states, quantum fluctuations would occur and would lead to structure such as what we observe today.

Again initially assuming certain classical energy conditions, Stephen first proved that the surface area of a black hole could never shrink. Later he showed that quantum theory would produce violations of the energy conditions assumed in the area theorem and produce the famous Hawking radiation and cause black holes eventually to shrink and most probably evaporate away entirely.

I first met Stephen when he came to Caltech 1974-75, where I was a graduate student with Kip Thorne. I had been one of several, after Zel'dovich and Starobinsky, who independently realized that rotating or charged black holes would give spontaneous emission into the superradiant modes, and when Doug Eardley told Stephen of my work, Stephen talked to Zel'dovich

and Starobinsky about it, liked their idea but was not satisfied with their derivation, and so did it himself in late 1973, finding to the surprise of all of us, that all black holes emit radiation, not just rotating or charged ones.

After learning of Hawking's exciting new results, I began making numerical calculations of the rates for the various frequencies ("calculating the colour of a black hole," as Richard Feynman later described my 1976 Ph.D. thesis). During Hawking's 1974-75 visit to Caltech, I discussed these issues with him and also wrote a paper with him deducing an upper limit to the number of primordial black holes small enough to have emitted much radiation by the present time. However, inflation may have made the early universe so smooth that very few primordial black holes were formed, and we have no firm positive lower limit on their number density.

After finishing my Ph.D., I had the great opportunity to be Stephen's postdoc here in Cambridge 1976-79, working on Euclidean quantum gravity and finding some new gravitational instantons. I also had the privilege to live with the Hawkings and help him get up, get dressed, eat breakfast, and go into DAMTP on Silver Street, while Jane got their children ready for school.

As many of you know, Stephen and I had different theological opinions, which Stephen generally accepted with his good-natured humour. For example, in the morning before getting Stephen up, I would usually read the Bible and then often tell Stephen a bit of what I had read.

On day I told Stephen about Matthew 8:28-34. where Jesus cast out an evil spirit into swine who rushed down into the sea. Stephen responded, "The Society for the Prevention of Cruelty to Animals wouldn't like that story, would they?"

Another morning I recounted to Stephen the parable of the worker in the vineyard in Matthew 20:1-16 (where all got paid the same full day's pay, no matter how long they had worked), and Stephen retorted, "The trade unions would not like that story, would they?"

During another breakfast when I was feeding him, I told Stephen about Matthew 24:40-42 ("Then there shall be two men in the field; one will be taken, and one will be left. Two women will be grinding at the mill; one will be taken, and one will be left. Therefore be on the alert, for you do not know which day your Lord is coming.") Stephen piped up, "Or two at the breakfast table."

Besides being an outstanding scientist and excellent mentor to me, Stephen was also a very close personal friend. My last time seeing him was May 25, 2016, when most of our family was travelling around Europe and England, and Stephen invited us to dinner at his home after my seminar on "Naked Firewalls" at the Centre for Mathematical Sciences here. Stephen's housekeeper Diana Briscoe cooked a wonderful meal, and our family will always treasure that time with Stephen.

Thus not only do I owe my career to Stephen, but I also deeply appreciated his friendship to me and to my family.