



# Are we the world's heroes?



Are human beings an endangered species? Sir David Attenborough believes that human beings may be endangered.<sup>1</sup> Are we destined to go the way of the dinosaurs and the dodo?

Attenborough considers the population growth rate and available resources, and projects problems unless we change. This is an argument that dates back to Malthus,<sup>2</sup> who wrote that population growth would be limited by famine or catastrophe.<sup>3</sup> Given humanity's history, wars over resources do not seem unlikely, and war in modern times is much more serious than in the past because of weapons of mass destruction (nuclear weapons, chemical weapons, and biological weapons), any of which could eliminate life as we know it.

In fact, there seems to be an endless stream of threats to the existence of humanity. Large bodies from space (meter size or larger) frequently intersect the earth's orbit. Collisions of such large bolides (approximately 10 km in diameter) with the earth have been postulated to be responsible for previous great extinction events.<sup>4</sup> In 1908, a bolide projected to be 60–190 m in diameter caused damage over an area of 2150 square kilometers in Siberia.<sup>5</sup> In 2013, a bolide projected to be 17–20 m in diameter caused damage over a smaller area in Siberia near the city of Chelyabinsk.<sup>6</sup> The frequency of these occurrences is inversely correlated with the mass of the bolide, so that those large enough to cause extinction events only recur on geological time scales, although some believe that they occur more frequently.<sup>7</sup> Are we overdue for such an event?

Other events in outer space that would threaten a great extinction include the explosion of a supernova anywhere in our galactic neighborhood,<sup>8</sup> or the intersection with earth of a gamma-ray burst from somewhere nearby.<sup>9</sup> The earth's

magnetic poles have flipped many times.<sup>10</sup> When this occurs, the magnetic fields around the earth that protect us from high-energy particles emitted by the sun reorient and reestablish themselves. During that time period, the magnetic fields around the earth and the pole formation may be chaotic. No one knows whether that time period is seconds, years, decades, or longer. It is hard to determine what impact this would have on life on earth.

On earth, we face catastrophe from supervolcanoes and large earthquakes. Supervolcanoes are those that can throw out up to 1000 km<sup>3</sup> of dense material in a single eruption.<sup>11</sup> The volcano under Yellowstone National Park in the United States is one that has such potential. There are others at various locations around the world. Large earthquakes are those of a magnitude large enough to cause widespread devastation. The US Geological Service lists five such earthquakes with a magnitude of 9.0 and above worldwide since 1900, and 12 more with a magnitude of 8.5 or above since 1900.<sup>12</sup> Supervolcano events will almost surely be accompanied by clusters of large earthquakes.

We face the threat of global pandemics. We are experiencing one such scourge in western Africa today because of the eruption of the Ebola virus.<sup>13</sup> Thousands have died to date, and this is not even the worst strain of Ebola known. Will we see some form of a supervirus or other superbug plague humanity? Will it kill large numbers of us, or will it change us in some way? Are some of us destined to become flesh-eating zombies, chasing a smaller population of those who are still human?

We also face potential threats from global climate change, which include temperature extremes and ferocious storms such as hurricanes and tornadoes of unprecedented strength.<sup>14</sup>




Where are the heroes who will save humanity from these catastrophes? Will Professor Xavier's X-Men arise to save us from the zombies? Will Superman and the other members of the Justice League emerge to protect us from the other events? Will Tom Swift and his incredible rocket ship deflect bolides to keep them from impacting the earth? Where are Spiderman, Green Lantern, Iron Man, and others when we need them?

Dare I say that the heroes we need are within the ranks of the materials research community? Humanity's best hopes lie with research into methods that would prevent or mitigate such disasters. We have developed camera systems that are scanning the skies to detect bolides that have a chance of impacting the earth. The sensitivity and resolution of these cameras owe much to materials research. We have space launch capabilities so that we can direct systems to meteors, asteroids, and comets with the intent to deflect them away from earth. Those capabilities also owe much to materials research.

Is it impossible to believe that we can develop new materials and systems that will help us to cope with the threats of global climate change, including superstorms? Perhaps we can develop stronger materials for buildings and better materials for storm surge barriers and floodgates. Can we develop new approaches to civil engineering on a massive scale that would allow us to conquer supervolcanoes to prevent their eruption or to significantly mitigate their effects? Perhaps we could construct massive tunnels to allow magma to flow freely to ease the pressure buildups that cause catastrophic eruptions. We might even be able to harvest some elements from the magma for use in other activities. Can we invent new medicines and new approaches to medical research that will allow us to respond more swiftly to global pandemics? Can we develop vaccines or treatments for Ebola or cancer, or medicines that attack and remove amyloid plaques from brain tissue? Is it mere science fiction (or science fantasy) to imagine that we could develop shields that would protect us in the event of a nearby supernova or a gamma-ray burst directed toward earth?

We humans are an ornery, contentious species, who inhabit one small planet in one arm of a vast spiral galaxy. Perhaps the process of learning to protect the earth from natural catastrophe would also guide us toward learning to live together in peace and



## Materials scientists to the rescue!

harmony. Of course, this may all be moot if (as some believe) evolution of the Higgs field may result in vacuum fluctuations that could wipe out the universe,<sup>15</sup> or if evil aliens from outer space attack us with the intent to exterminate all human life.<sup>16</sup>

**Steve Moss**

### References

1. <http://www.independent.co.uk/arts-entertainment/tv/news/sir-david-attenborough-humans-may-be-an-endangered-species-9950523.html>.
2. [http://en.wikipedia.org/wiki/Thomas\\_Robert\\_Malthus](http://en.wikipedia.org/wiki/Thomas_Robert_Malthus).
3. T.R. Malthus, *An Essay on the Principle of Population* (Oxford University Press, UK, 1993).
4. [http://en.wikipedia.org/wiki/Impact\\_event](http://en.wikipedia.org/wiki/Impact_event).
5. [http://en.wikipedia.org/wiki/Tunguska\\_event](http://en.wikipedia.org/wiki/Tunguska_event).
6. [http://en.wikipedia.org/wiki/Chelyabinsk\\_meteor](http://en.wikipedia.org/wiki/Chelyabinsk_meteor).
7. [http://en.wikipedia.org/wiki/Holocene\\_Impact\\_Working\\_Group](http://en.wikipedia.org/wiki/Holocene_Impact_Working_Group).
8. [http://en.wikipedia.org/wiki/Near-Earth\\_supernova](http://en.wikipedia.org/wiki/Near-Earth_supernova).
9. <http://www.livescience.com/49040-gamma-ray-burst-mass-extinction.html>.
10. [http://en.wikipedia.org/wiki/Geomagnetic\\_reversal](http://en.wikipedia.org/wiki/Geomagnetic_reversal).
11. <http://en.wikipedia.org/wiki/Supervolcano>.
12. [http://earthquake.usgs.gov/earthquakes/world/10\\_largest\\_world.php](http://earthquake.usgs.gov/earthquakes/world/10_largest_world.php).
13. <http://www.cdc.gov/vhf/ebola>.
14. <http://www.gfdl.noaa.gov/global-warming-and-hurricanes>.
15. <http://www.livescience.com/47737-stephen-hawking-higgs-boson-universe-doomsday.html>.
16. See the movie *Independence Day*.

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