

OUT THERE

This Star Looked Like It Would Explode. Maybe It Just Sneezed

The mysterious dimming of the red supergiant Betelgeuse is the result of a stellar exhalation, astronomers say.



By **Dennis Overbye**

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Apparently a star can sneeze.

That is what happened to Betelgeuse, the red supergiant star that marks the armpit of Orion the Hunter, according to Andrea Dupree, associate director of the Harvard-Smithsonian Center for Astrophysics. She and an international team of astronomers described that conclusion in a paper published this week in *Astrophysical Journal*.

Betelgeuse, one of the brightest and most prominent stars in the winter sky, began dramatically and mysteriously dimming in the fall of 2019, dwindling to less than half its normal brightness. By February 2020, it was the faintest that it had been since measurements began more than 150 years ago, according to Dr. Dupree.

“The dimming was obvious to everyone when looking at the constellation Orion,” she said. “It was very weird. Betelgeuse was almost missing,”

Some astronomers and excitable members of the public wondered if the star was about to explode as a supernova. Such aging stars are notoriously cranky and moody, sputtering out bursts of gas and dust as their cores evolve and change.

Something like that was happening to Betelgeuse last year, Dr. Dupree's team now reports. Observations in ultraviolet light with the Hubble Space Telescope revealed gobs of dense hot gas shooting out through the upper parts of atmosphere of Betelgeuse at speeds of 200,000 miles an hour, "almost like a sneeze," Dr. Dupree said.

At the same time a robot telescope called Stella — the STELLA Robotic Observatory, in Tenerife, Spain — recorded the surface of the star pulsating outward, helping to propel the hot gas.

The surface of Betelgeuse, like that of the sun, is covered with big blobs of rising and falling gas, called convection cells, that transmit energy from the interior. "We suspect that there was a confluence of a big convective cell on the surface and also the outward radial velocity that acted together to eject this material," Dr. Dupree said in an email.

Radial velocity measurements showed that the surface, or photosphere, was moving out during 2019. From May to August, Betelgeuse was near the sun and out of view, she said: "And in September we saw this bright hot dense material moving out from the southern part of the star."

Once the gas had gone a few million miles from the star, it cooled into a dust cloud that obscured the southern part of Betelgeuse.

An artist's rendering showing how Betelgeuse's southern region may have suddenly become fainter for several months. NASA, ESA, and E. Wheatley (STScI)

In an email, Edward Guinan of Villanova University, who has been tracking Betelgeuse, called the new Hubble data “fantastic,” and said Dr. Dupree’s theory was “a good working hypothesis.” He added: “But I don’t entirely agree that the ‘Mystery’ is now solved.”

He noted that alternative explanations could explain the dimming: giant sunspots, perhaps, or gigantic rising convection cells tens of millions of miles across, radiating away their heat and energy and then cooling, turning over and sinking again.

Adding to the mystery is that Betelgeuse, after regaining its normal luminosity this May, has started to dim again. Betelgeuse has long been known to vary in brightness — although not so extremely as this year — in accordance with a 420-day cycle of pulsation in its size, so this new fading is occurring early, for reasons unclear.

That the star will eventually blow up is certain. Betelgeuse, sometimes pronounced “beetle-juice,” and also known as Alpha Orionis, is at least 10 times and maybe 20 times as massive as the sun. If it were placed in our solar system, its fiery gases would engulf everything out to Jupiter’s orbit.

The star is a so-called red supergiant in the last violent stages of its evolution. It has already spent millions of years burning primordial hydrogen and transforming it into the next lightest element, helium. That helium is burning into more massive elements. Once the core of the star becomes solid iron, sometime within the next 100,000 years, the star will collapse and then rebound in a supernova explosion, probably leaving behind a dense nugget called a neutron star.

Whatever Betelgeuse is going to do, it might have already done; we are just waiting for the news. The star is some 725 light-years away, so the light visible from Earth today, whether rising or falling, left the star around the year 1300.

“No one knows how a star behaves in the weeks before it explodes,” Dr. Dupree said. “And there were some ominous predictions that Betelgeuse was ready to become a supernova. Chances are, however, that it will not explode during our lifetime. But who knows?”

Dr. Guinan said: “I am really looking forward to seeing what the star will do this season. It will be fun to see.”