This Week's Citation Classic

CC/NUMBER 4
JANUARY 26,1981

Colgate S A & White R H. The hydrodynamic behavior of supernovae explosions. *Astrophysical J.* 143:626-81, 1966.
[Lawrence Radiation Lab., Univ. California, Livermore, CA]

Numerical hydrodynamics calculations are made of the collapse of a presupernova star. The shock formed on the resulting neutron star and neutrino diffusion causes a supernova explosion. [The *SCI*® indicates that this paper has been cited over 300 times since 1966.]

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December 1, 1980

"This paper paralleled the important work of Burbidge, Burbidge, Fowler, and Hoyle in 1957.[1] It is an attempt to understand whether a supernova could explode in such a fashion as to produce cosmic rays as suggested by myself and Johnson in I960.[2] It was the first attempt to apply one of the numerical hydrodynamic codes to the problem of the collapse and explosion of a star. The first attempt at producing an explosion from a thermonuclear detonation as suggested by Burbidge et a/, resulted in a miserable failure and further collapse of the star. The ultimate end point of that collapse was soon recognized as a neutron star and the problems of the equation of state and stiffness of such an object became the central point of the hydrodynamic calculations. The transport of energy from such a collapse to the mantle was a puzzle. When the transport of heat of the shock wave by neutrinos was approximated in the hydrodynamic codes in a particular fashion, namely, the luminosity of the shock wave emitting neutrinos and the subsequent deposition of some of these neutrinos as heat in the surrounding mantle of the star, then this indeed produced an explosion. Many supernova calculations since the time of this paper have demonstrated an increasing hierarchy of subtleties and difficulties to this original concept. As of this writing there is as yet no agreed upon mechanism for the explosion of the supernova star. It is still a central question of modern high energy astrophysics. Calculations that are performed now are similar to those that were done so many years ago but with more accurate equations of state[3]and far more subtlety in neutrino processes.

"The reason this paper is cited so many times is because it started the new endeavor of hydrodynamic stellar modeling. It is ironic that this work started because of an argument with Soviet scientists during the negotiations for the Cessation of Nuclear Weapons Tests in Geneva in 1959. It was claimed by me that the radiation emissions from a supernova might trigger the then proposed detection net for high altitude nuclear explosions that the Soviets were proposing. This objection of a possible false triggering of the system was brushed aside by the Soviet Ambassador Tsarpkin because, 'Who knows what a supernova would look like?' The activity of continuing to model supernova explosions has been one that has stimulated new thought in many areas of astrophysics."

1. **Burbidge E M, Burbidge G R, Fowler W A & Hoyle F.** Synthesis of the elements in stars. *Rev. Mod. Phys.* 29:547-650, 1957.
2. **Colgate S A & Johnson M H.** Hydrodynamic origin of cosmic rays. *Phys. Rev. Lett.* 5:235-8, 1960.
3. **Bethe H A, Brown G E, Lattimer J & Applegate J.** Equation of state in the gravitational collapse of stars. *Nucl. Phys A* 324:487-533, 1979.