Review of

The Big Bang

A History of Explosives

George I. Brown

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George Brown's *The Big Bang*, subtitled A History of Explosives is a good popular treatment of explosives from the ninth century AD to modern times. The first third of the book is taken up with gunpowder, starting with its obscure origins in China. In a section on rockets, Brown mentions the use of metallic colored-flame agents. Most of what he says is right, but calcium gives an orange and not a red color, and antimony sulphide (sic) is not the agent of choice for white. He ends this part of the book with a brief (one paragraph) treatment of modern firearms. Unfortunately, the importance of two major advances—recoil-operated machine guns and fixed ammunition (projectile, propellant, and primer in a single cartridge)—is not mentioned.

Brown goes on to discuss the use of gunpowder in mining and civil engineering, and tells the story of Davy's invention of the miner's safety lamp, usable even in explosive concentrations of 'fire-damp' (methane). He then talks about some early explosives based on chlorates, but with no mention of Sir William Armstrong and his deadly chlorate-phosphorus-sulfur mixtures. Another omission is flash powder, a material widely used to produce big bangs in fireworks. There is an account of other explosives based on liquid oxygen, as well as various mixes and slurries using ammonium nitrate.

The next sections of the book are on modern explosive materials and their development—nitroglycerin, dynamite, nitrocellulose, and similar nitration-based technologies. Brown discusses the two giants in the field, Alfred Nobel and Fritz Haber, both really tragic figures. Nobel hated guns and all things connected with war but developed the basic technology widely used in WWI and subsequent wars. He had much tragedy in his own life, including the death of his younger brother in the explosion of a Nobel nitroglycerin factory.

Haber invented the process for making ammonia from atmospheric nitrogen, for which he got the Nobel Prize in Chemistry in 1918. This 1909 work freed Germany from dependence on imported nitrates; without the Haber-Bosch process providing nitrate-based explosives and propellants Germany could not have continued with WWI, a great many lives would have been saved, and the course of history changed. Haber also provided the technology for Germany's WWI use of poison gas. He was forced to leave the country in 1933 when the Nazis rated hatred of Jews above his earlier services to Germany.

Brown then turns to guncotton, invented by Schonbein, and its major use in smokeless powder. Since smokeless powder had more energy than Black Powder, it permitted lighter ammunition and smaller-bore, lighter firearms. Nobel appears again with the invention of blasting gelatine in 1875.

The next chapter discusses Lyddite (trinitrophenol) and TNT. Brown tells the story of the naval battle at Jutland in which British shells filled with Lyddite exploded from shock on contact with steel plate, while German shells filled with TNT could be fused to explode after penetrating armor, and thus do more damage.

Brown's "Setting It Off" chapter discusses how explosives are successfully initiated. Here too Nobel leads the field. His invention of the multiple-explosive initiating device was probably more important than his invention of dynamite; blasting caps and military detonators using a multiple-explosive sequence are now widely and routinely used. There is discussion of the development of percussion caps, safety fuse, and detonating cord.

The last quarter of the book is devoted to nuclear explosives. Brown quotes Oppenheimer, the leader of the Manhattan Project to develop

the fission bomb, who said of physicists, "We have blood on our hands". Alas, too true. The first use of this horrific technology was to kill and maim 280,000 men, women, and children at Hiroshima and Nagasaki; their only crime was to be in the wrong place at the wrong time

During most of the cold war the US and the USSR had many thousands thermonuclear weapons, and were prepared on a few minute's notice to kill tens of millions of civilians on 'the other side'. Brown tells the story of the extraordinarily talented scientists who brought these devices into existence, including Einstein, Fermi, Feynman, Oppenheimer, Sakharov, Szilard, and Teller. Some like Einstein, Szilard, and Sakharov came to understand the terrible implications of nuclear weapons and sought to mitigate the horrors; others, most notably Edward Teller and his protégé Lowell Wood, thought that thermonuclear devices could solve almost any military problem.

Brown's description of nuclear weapons technology is quite good. However, he omits what I believe are two significant matters. The first is the great importance of absolutely-simultaneous detonation of all the chemical explosive sections of an implosion-triggered fission device. This and other exacting technical requirements have made it (fortunately) quite difficult for nuclear wanna-be's to achieve a successful fission explosion.

The second of these matters is the Fission-Fusion-Fission bomb, in which the tamper that concentrates X-ray radiation from the fission device toward the fusion fuel is made of an inexpensive fissionable material like U238 or thorium. This technique can be used to build bombs of unlimited size rather cheaply. Unfortunately, these bombs also produce a large amount of fallout.

At the end of the book there are two appendices dealing with chemical and energetic details. The first is on Names and Formulae, and the second is on Energy and Power.

There is a two-page bibliography. It includes Urbanski's *Chemistry and Technology of Explosives*, but not Davis's *The Chemistry of Powder and Explosives*. Davis's work is older than Urbanski's, but it is still a useful reference.

Pyrotechnic aficionados may be disappointed that the only fireworks reference is to Plimpton's *Fireworks, a History and Celebration*. It might have been a good idea to include more practical and detailed works like Shimizu's *Fireworks, the Art, Science, and Technique*, Lancaster's *Fireworks Principles & Practice* and Perigrine's *Introductory Practical Pyrotechnics*.

There are numerous footnotes, and a complete index (always a blessing).

I think Brown has done an excellent job; the material is readily available to the non-technical reader, all the important facts and history are covered, more sophisticated readers will still learn something, and it is a good 'read' with many fascinating and often tragic stories.