Nevada Test Site History

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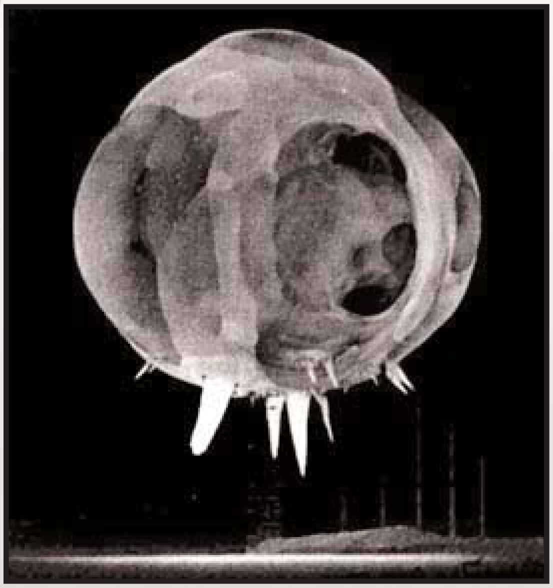
Rapatronic Photography at the Nevada Test Site



This rapatronic image, captured during the Tumbler-Snapper series at the Nevada Test Site in 1952, illustrates the phenomenon known as the "rope trick."

A rapatronic photo captures a tower test during Tumbler-Snapper immediately after detonation, but before the "rope trick" is visible.

Introduction

They are some of the most famous and eerie images to emerge from the Cold War: atmospheric nuclear tests captured one millisecond after detonation. Using a rapatronic camera developed by Harold Edgerton of Edgerton, Germeshausen & Grier Inc. (EG&G), a company specializing in electronic technology, the rapatronic camera was capable of photographing still images at the rate of 1/1,000,000 of a second.

Background

Dr. Harold Edgerton, a pioneer in strobe photography, developed the concept for the rapatronic camera in the 1940s. With partners Germeshausen and Grier, Edgerton made the first rapatronic camera capable of recording still images of rapidly-changing subject matter from as far as seven miles away. Called 'rapatronic' for its rapid action electronic shutter, the cameras were used to photograph atmospheric nuclear tests at the Nevada Test Site primarily during the Tumbler-Snapper series in 1952, and Operation Upshot-Knothole in 1953. The rapatronic photographic technique enabled very early capture on film of the nuclear fireball immediately after detonation. The exposures were often as short as 10 billionths of a second, and each camera could take only one photograph. As a result, banks of four to 10 cameras were set up to take sequences of photographs during a single nuclear test.

The images

Valuable data about nuclear tests resulted from the rapatronic images. Photos resulting from the rapatronic technique revealed, for the first time, misshapen fireballs immediately after detonation of atmospheric nuclear tests - many of which were detonated atop 300-foot towers. Many of the photos reveal two striking features: glowing spikes projecting from the bottom of the fireball, and a peculiar mottling of the actual fireball.

The spikes protruding from the lower part of the fireball result from the fire extending and burning along ropes or cables that stretch from the shot cab (the housing for the test device at the top of the tower) to the ground. Physicist Dr. John Malik researched this phenomenon and appropriately named it a "rope trick." The effect had been observed in earlier tests when spikes were seen extending along cables that moored the shot towers to the ground. During the Snapper phase of the Tumbler-Snapper series, Malik conducted experiments using different kinds of cables and ropes, and with different surface treatments.

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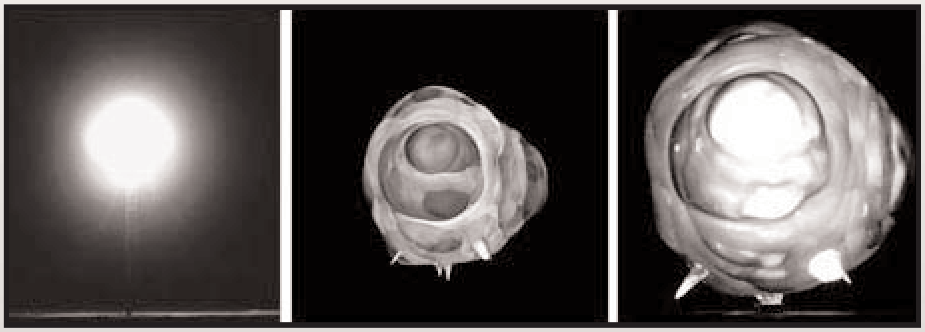
Malik observed that if the rope was painted black, the spike formation was augmented, and if it was painted with reflective paint or wrapped in aluminum foil, no spikes were observed in the rapatronic images. Malik's experimentation confirmed the hypothesis that it is the heating and vaporization of the rope induced by exposure to high intensity visible light radiation which caused the "rope trick" effect.

Lea, part of Operation Hardtack II, was detonated at the Nevada Test Site on October 13,1958.

The cause of the surface mottling in the rapatronic images is more complex. Immediately after detonation, the growth of the fireball is due to radiative transport - thermal x-rays "outpacing" the actual expanding bomb debris. Milliseconds later, a hydrodynamic shock front forms, and the fireball expansion is caused by the shock front-driven hydrodynamic pressure. As the shock compression heats the air, the fireball grows far more slowly than it did directly after detonation. The debris from the actual bomb and shot cab is vaporized, and the vapors are initially accelerated to very high velocities before the shock front forms. Once the shock front forms, clumps of the material splash against the back of the shock front in an irregular pattern creating the mottled appearance.



Rapatronic images captured in succession during an atmospheric tower test in the Snapper phase of the Tumbler-Snapper series.

In addition to rapatronic images captured during the Tumbler-Snapper series and Operation Upshot Knothole at the Nevada Test Site, rapatronic images were also taken during Operation Greenhouse in 1951 and Operation Redwing in 1956, both conducted in the Pacific; and Operation Hardtack II in 1958, conducted at the Nevada Test Site.

Because the rapatronic camera could only take one photo, banks of cameras were needed to photograph a single nuclear test.

Conclusion

Rapatronic images provided a valuable tool for scientists to understand the events that occur in the milliseconds after the detonation of a nuclear bomb. The images prompted research and validation of new concepts, and brought Dr. Harold Edgerton, the father of rapatronic photography, acclaim for his contributions to science and photography. He received the Medal of Freedom, the National Medal of Science, the National Medal of Technology, and the International Center of Photography's Lifetime Achievement Award.

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