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# FIREBALL SPIKES--THE PLUMBBOB BOLTZMANN AND FRANKLIN ROPE TRICKS

by

A. T. Peaslee, Jr.

ABSTRACT

Some experiments, aptly called "rope tricks," were performed on Plumbbob events Boltzmann and Franklin to further studies on spikes on fireball photography. These form on long cables emanating from tower or balloon cabs. The most interesting data resulted from a black cable between a weather balloon and the tower cab on Boltzmann. The report contains results previously available in internal Los Alamos documents written in 1957.

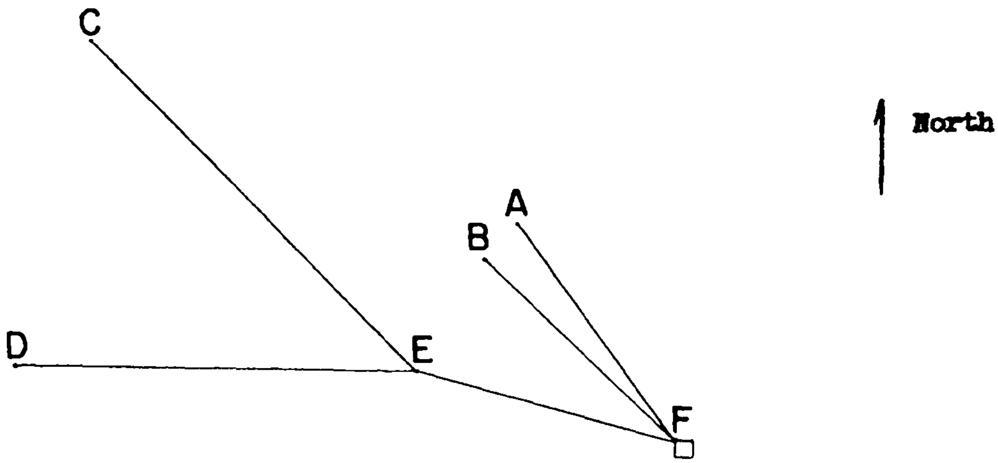
## I. INTRODUCTION

Several rope tricks to further study of the phenomena of spikes on fireballs were performed on Boltzmann and Franklin. This was a continuation of work by Malik.[1] This report summarizes the preshot phase of the experiments and the early qualitative results, which are based on an incomplete study of the shot photographs. They were first published in internal laboratory documents in 1957.

## II. BOLTZMANN

### A. Bifurcated Cable

A 1/4-in.-diam steel wire rope was strung from the NW corner of the cab floor of Tower T-7c, NTS coordinate N854124 E687540, toward the EG&G phototrailers at G-15-5006, located north of 7-357, NTS coordinate N855974 E680104, to point E (Fig. 1); there the wire rope joined onto two other 1/4-in.-diam steel wire ropes which terminated at small concrete anchors on the ground at points C and D. The angle between FE extended and ED, EC are $\sim 15°$ and $\sim 30°$, respectively. The principal mass components in Tower 7c are shown in




| | |
|---|---|
| A: N 854,420.84<br>E 687,329.21 | D: N 854,240.63<br>E 686,654.95 |
| B: N 854,381.64<br>E 687,282.48 | E: N 854,231.27<br>E 687,191.42 |
| C: N 854,674.43<br>E 686,763.47 | F: N 854,133.66<br>E 687,540.18 |

Fig. 1. Arrangement of cables for Boltzmann. Note: The coordinates for point F were obtained by assuming point F was 10 ft N and 10 ft W of the working point. Point F is approximately 500 ft above ground. Point E is approximately 300 ft above ground.

Fig. 2. The fireball was photographed from the directions shown. The photos of Figs. 3-6 are from station G-15-5006.

The purpose of the bifurcated cable was to obtain a measure of the spike's inertia by observing whether or not the spike would stop, fork, or continue straight ahead when it came to the bifurcation. If spike phenomena are the same as shock tube boundary disturbances,[2] the spike would be expected to travel down ED and perhaps a little bit down EC and straight ahead. Unfortunately, the FE cable spike died out before it reached the fork.

B. Cone Effect

Two unpainted 1/4-in.-diam manila ropes extended from the NW corner of the cab floor to metal stakes at points A and B on the ground (Fig. 1). Together with the upper NW guy cable, these ropes formed a trihedral angle with about 10° sides. This experiment was to see if the spikes would fill in the trihedral angle.

Spikes on the ropes and cable wave were seen at 0.498 ms on Rapatronic photo R9. At 14.5 ms on Fastax film $F_{35}$ - 2, the spikes were still separate and the rope spikes were fading. By 20.3 ms, the rope spikes had almost disappeared and the NW guy cable spike looked the same as all the other guy cable spikes.

This experiment strongly suggests that it is not possible to asymmetrically direct sizeable amounts of energy from low-yield devices by means of a cone effect.

C. Indian Version

A 500-g neoprene weather balloon inflated to give about 5-1/2 lb lift was attached to the cab roof by means of 200 ft of black-painted 3/6-in.-diam nylon cord. This experiment was to determine the behavior of a spike when it comes to the end of its rope and to compare this behavior with that of a shock tube boundary disturbance along a terminating wire.

A spike had gone about 90 ft up the cable at 0.498 ms (Fastax photo R9). This spike was more developed than any other cable or rope spike and was comparable with the tower leg spikes. The black paint was most probably responsible for drawing the balloon cord spike.

When the spike hit the balloon, it slowed, expanded radially, and was being overtaken by the fireball at 14.5 and 20.3 ms. This behavior is entirely consistent with the behavior of a shock tube boundary disturbance along a terminating wire. The spikes can be seen in the fireball pictures, Figs. 3-6.[3]

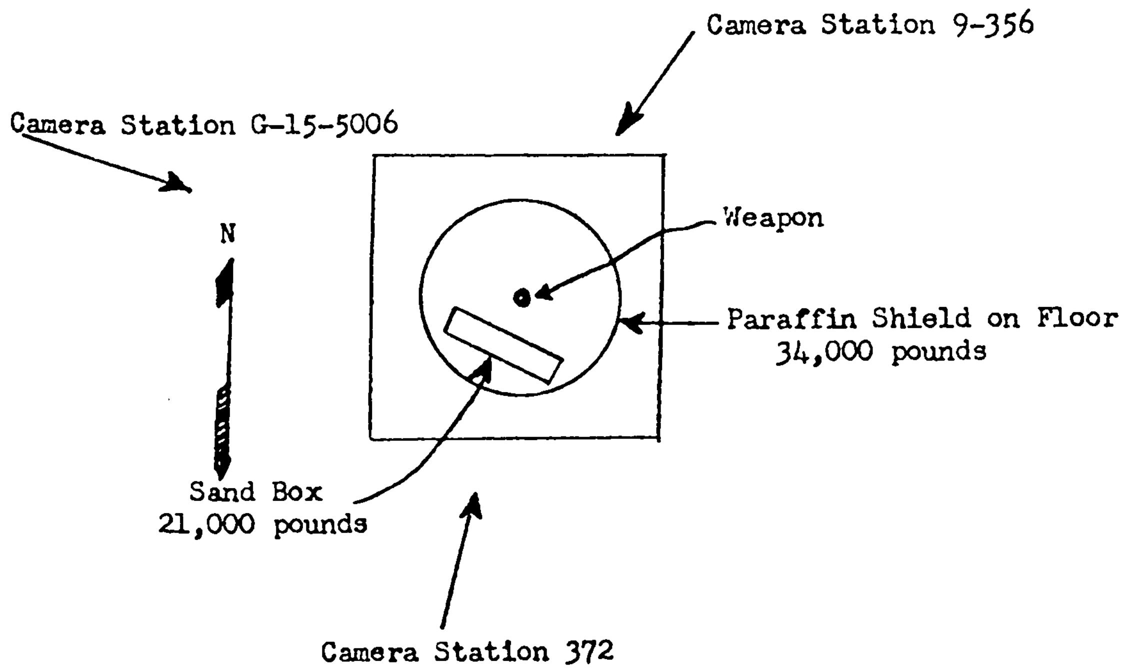



Fig. 2. Photographic coverage of Boltzmann.

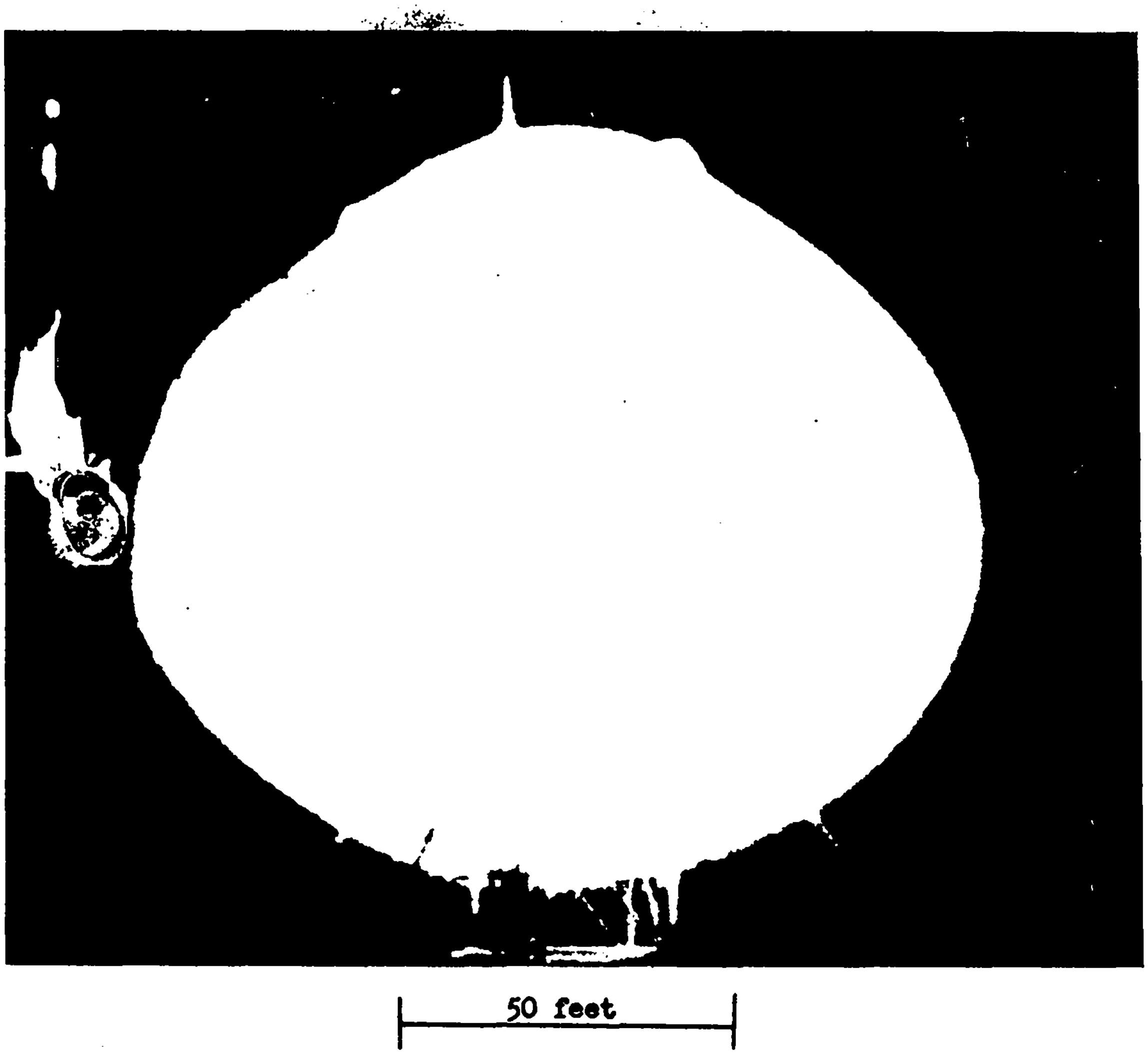



Fig. 3. Boltzmann fireball at 0.3 ms, from the west. (Rapatronic R10)

A box containing 11 tons of sand was placed to the right of the bomb as seen in this picture. This sand is holding back the fireball slightly on the right-hand side. A balloon was tied to the roof of the cab by a light nylon cord; a jet has formed on the cord at the top of the fireball. Jets have also formed on the light steel elevator cables and are just beginning to form on the heavy guy cables.

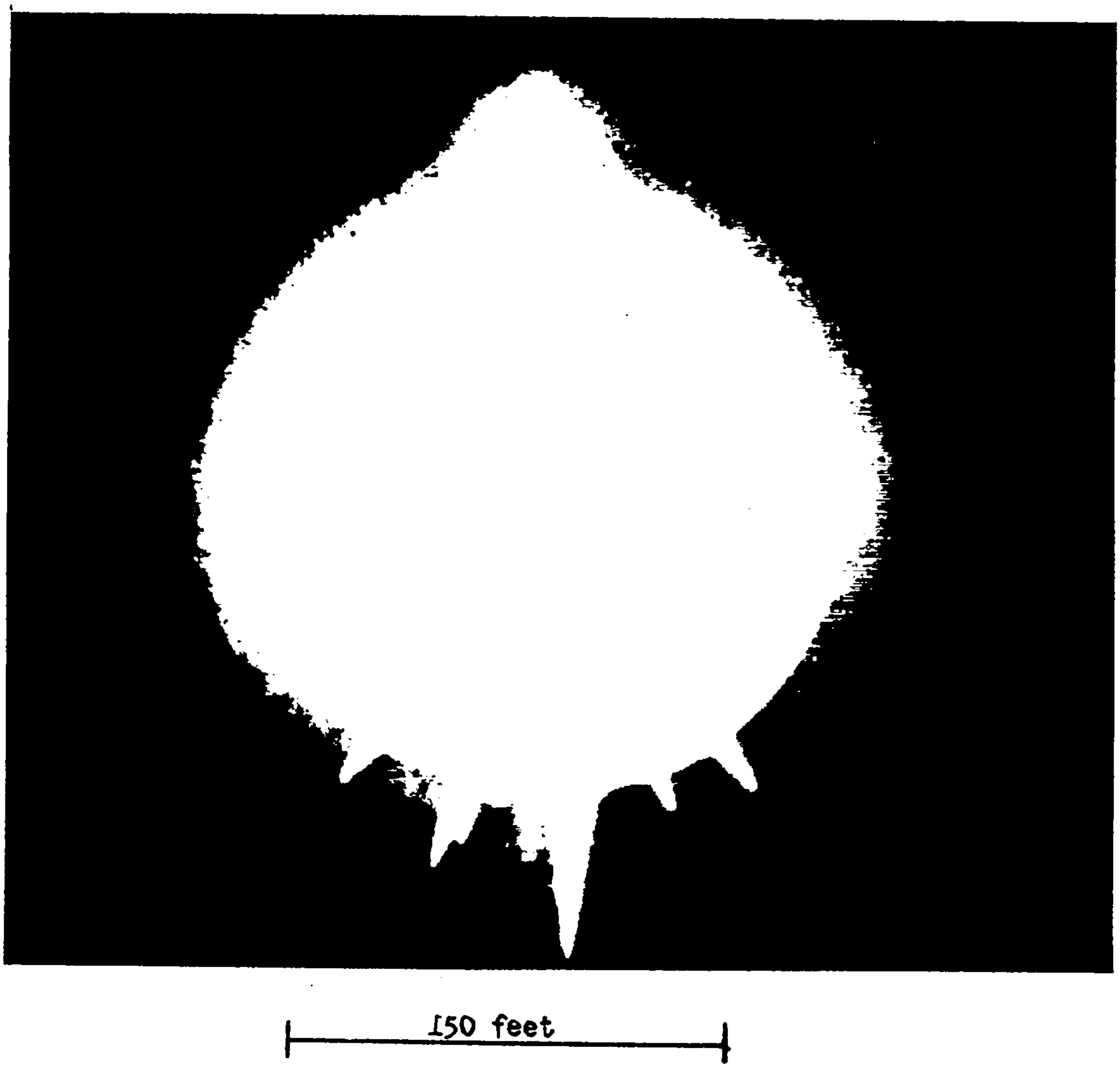
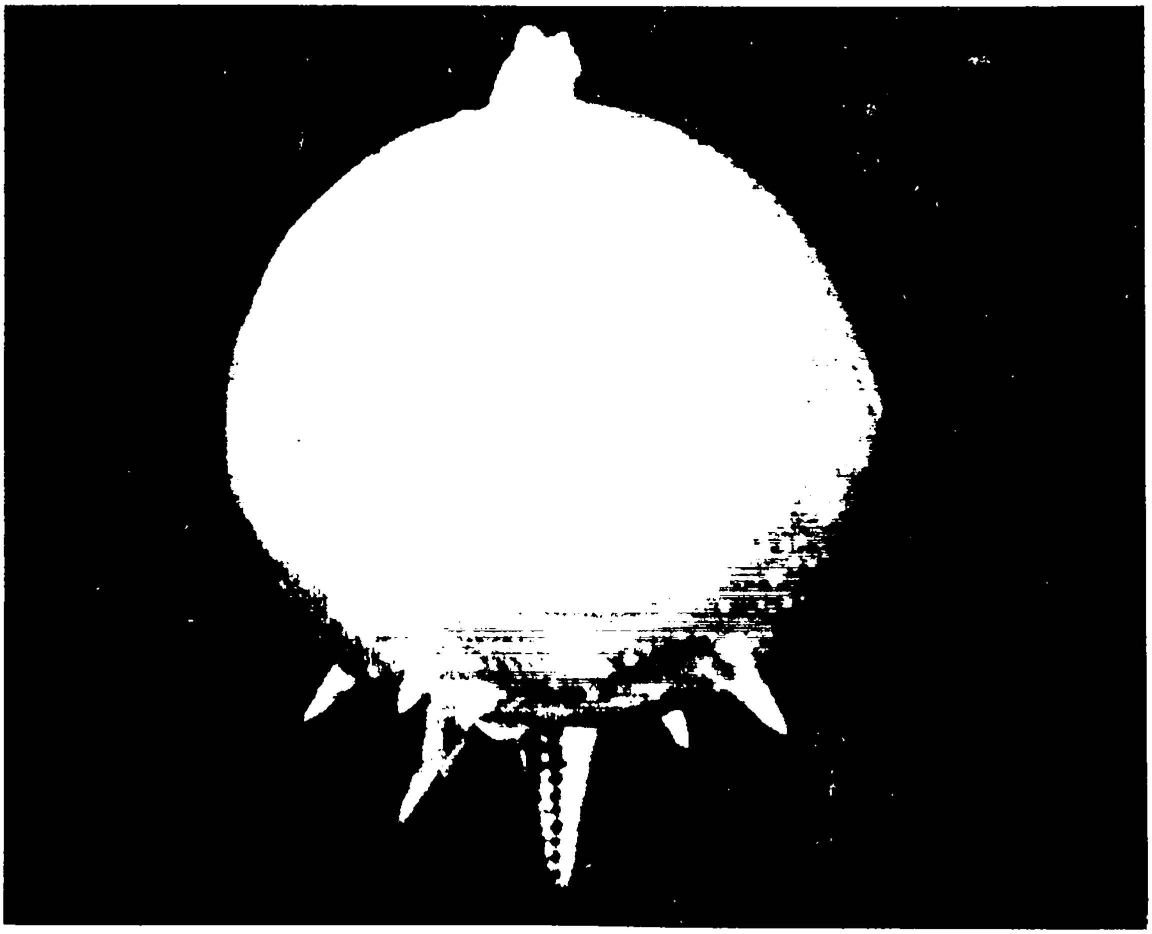



Fig. 4. Boltzmann fireball at 3.9 ms, from the west.

The fireball is now an almost perfect sphere. The small balloon above the tower has broken and the puff of smoke produced by the jet along the nylon cord has stopped growing radially but is expanding laterally. The other jets are growing.



200 feet

Fig. 5. Boltzmann fireball at 10.2 ms, from the west.

This picture was made at the time of the first light intensity minimum. The sandbox region at the right is now moving faster than the shock wave in other regions, a small bulge can be seen on the right side of the picture. The puff of smoke left by the nylon cord is expanding on top of the fireball. The effect of the corner posts and I-beams in the floor and roof of the cab can be seen. The projection of these structural members on the fireball surface produces a roughly circular pattern.

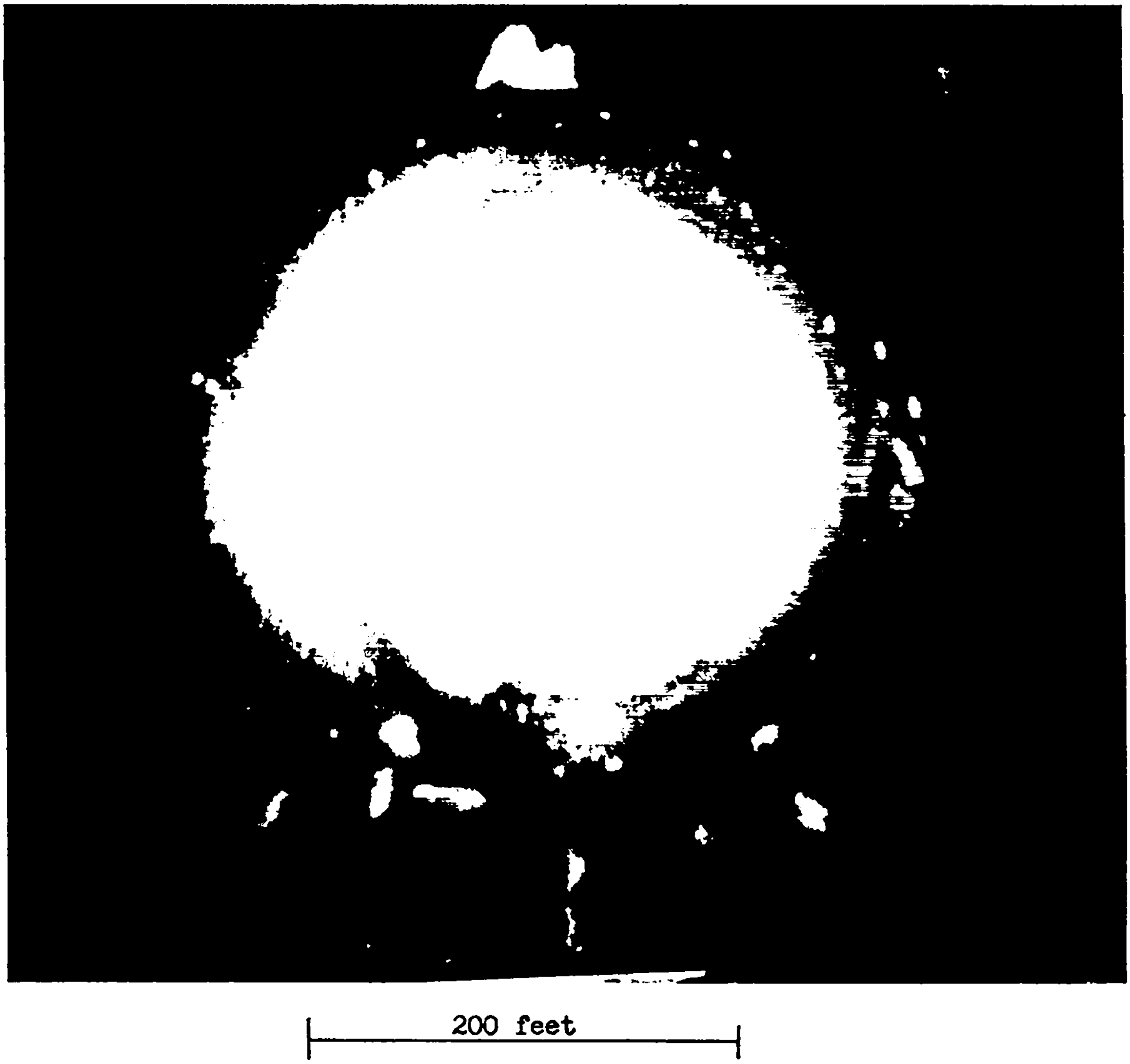



Fig. 6. Boltzmann fireball at 14.4 ms, from the west.

The bulge produced by the moving sand is now more pronounced, as can be seen on the right side of the fireball. The pattern on the fireball surface produced by the structural members is clear.

(Reference 3 contains the photo plan film members and Rapatronic photos at different times than shown here.)

This experiment strongly favors the radiation mechanism for spike formation. Fireball light transmitted through the air vaporizes and heats the cable material to almost the fireball surface temperature. The cable material then behaves as normal fireball constituents. The penetrating power of spikes from high-yield devices must depend on a later phase of spike development which is not reached in low-yield devices.

Although this experiment shows similarities between spikes and shock tube boundary disturbances, it clearly shows one difference: Spike formation is sensitive to the character of the cable surface, while boundary disturbances appear to be relatively insensitive to the boundary surface.

### D. Target Damage

Postshot inspection revealed no damage to the concrete anchor blocks, other than the cables being ripped off the outer anchor blocks. Several hundred feet of the guy cables and of the bifurcated cable survived. The fork in the 1/4-in. cable was not found.

## III. FRANKLIN

The Indian version was tried on Franklin but with the first 75 ft of nylon cord painted black, the next 50 ft unpainted, and the last 50 ft painted black. The color combination was to demonstrate the effect of the surface absorption of thermal radiation on spike formation. There was no photographic evidence of any spike formation, presumably because of the extremely low yield (0.14 kt).

## ACKNOWLEDGEMENT

The document for this report was resurrected and edited by John Malik.

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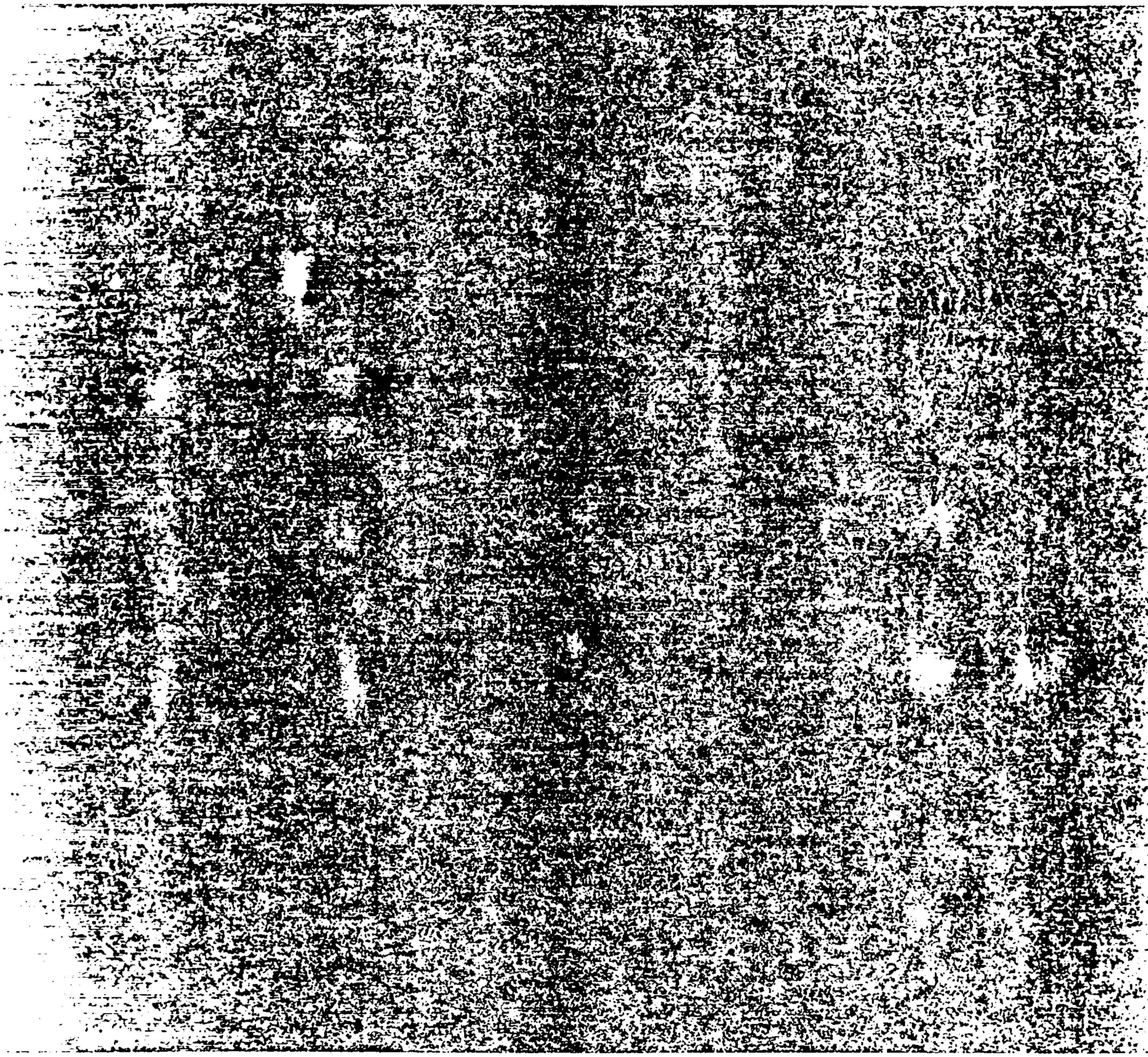

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