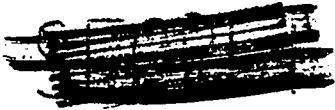


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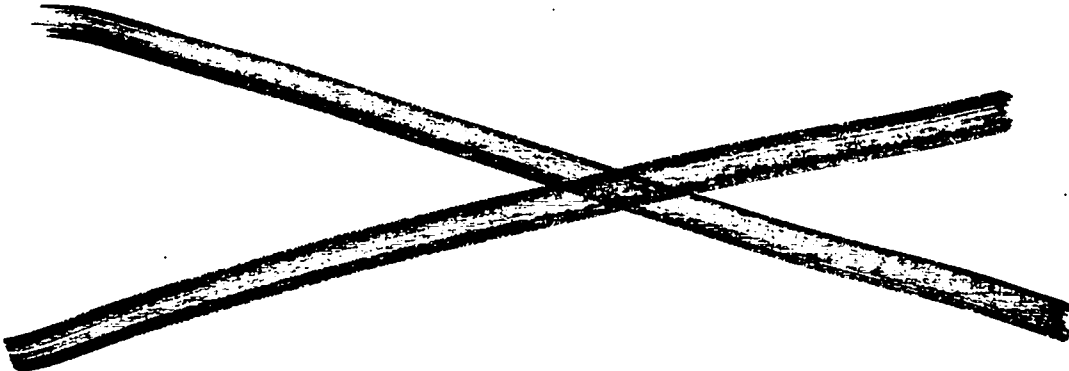
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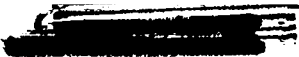
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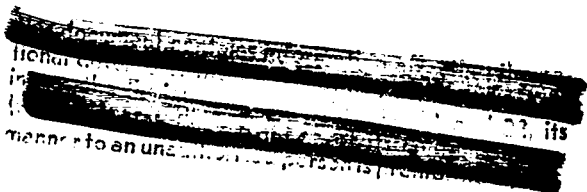
JULY 16th NUCLEAR EXPLOSION: GROUND VIBRATIONS

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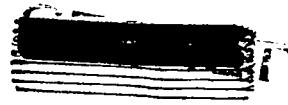
- T/4 Seymour Calvert
- J. Allon Crocker
- T/3 Carl Crumb
- T/5 Don Garrett
- H. Gewertz
- A. C. Graves
- E. R. Graves
- Pfc. George Hall
- T/3 Alan U. Hershey
- L. Don Leet
- T/4 John Lepman

REPORT WRITTEN BY:

L. Don Leet

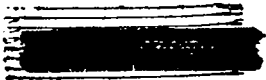


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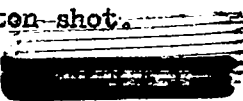
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ABSTRACT

Results from four 3-component portable seismographs which recorded the ground vibrations from the nuclear explosion of July 16, 1945 show that there was no possibility of damage to any houses in the towns of San Antonio, Carrizozo and Tularosa. At San Antonio, a distance of 28 miles, the maximum motion from the ground wave was .002 inch. Such displacements are less by a factor of 50 to 100 than any necessary to produce even minor damage in the form of small plaster cracks.

Geophone measurements at 9000 S indicate a yield of 15,000 tons in comparison with the results of the 100-ton shot.



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JULY 16th NUCLEAR EXPLOSION: GROUND VIBRATIONS

Five Leet three-component strong-motion seismographs¹⁾ were in operation at the time of this test. They were located and operated as listed in the following table.

Seismograph No.	Location	Distance	Azimuth	Operators
1	San Antonio	28 miles	305°	T/3 Carl Crumb T/4 John Lepman
2	9000 N	9000 yds	0°	E. Gewertz J. Allen Crocker Pfc. George Hall
3	Carrizozo (Cabin No. 4, Harry Miller's Place)	34 miles	95°	E.R. & A.C. Graves
4	Tularosa (Cabin No. 8, Camp Winco)	50 miles	145°	L.D. Leet T/4 Seymour Calvert
5	Elephant Butte (Cabin No. 4)	55 miles	225°	T/3 Alan U. Hershey T/5 Don Garrett

All records have been forwarded to me except the one for Elephant Butte. In view of the results at other stations, the Elephant Butte record is of no importance.

A particularly excellent and complete record was obtained at 9000 N. Motion was just large enough to record both ground and air waves at San Antonio. It was too small to record at any of the other stations.

Results at 9000 N

Fig. 1 shows the first motion at 9000 N; Fig. 2, the maximum motion; and Fig. 3, the air wave. The maximum motion occurred on the longitudinal component

1) For description of instruments, see "A Three-Component Portable Seismograph for the Measurement of Vibrations" in the Transactions of the American Geophysical Union, Volume 26, Part 1, 1955.

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(Horizontal-Radial) at 12.32 seconds and amounted to .025 inches (.125 centimeters double amplitude for comparison with geophone tables).

The geophones at 9000 N gave no records for direct comparison with my seismograph there. In the case of the 100-ton shot of May 7, 1945, geophone records at 9000 N showed maximum horizontal displacement 1.8 times the maximum at 9000 S. For the nuclear bomb shot of July 16, geophones at 9000 S gave a maximum double amplitude of .101 centimeters. If relationships were the same, this would indicate .182 centimeters maximum double amplitude, or .036 inches true amplitude, for 9000 N by the geophone records for comparison with the .025 inches obtained on the displacement seismograph.

Computation of TNT Equivalence

In LA Report 287 covering the 100-ton test at Trinity, formulas of C.W. Lampson were quoted in connection with computing the relationship between displacement and charge. I note that these formulas are not in agreement with extensive measurements made in connection with quarry blasting and insert the following for comparison. It has been found empirically that for buried charges the cube of the amplitude is proportional to the square of the charge. Using figures from 9000 S for both shots, this relationship would indicate that the gadget shot was 150 times the 100-ton shot, or 15,000 tons.

Calibration Shot

On July 14, 1945, a charge of 200 pounds of Composition B was buried eight feet at a distance of 200 feet from a pair of geophones and a Leet seismograph to permit a direct comparison between the geophones and the seismograph. A copy of the seismograph record is attached as Fig. 4. This shows a period at the maximum of .15 seconds and a maximum displacement on the longitudinal (Horizontal-Radial) component of .020 inches. The maximum displacement on the vertical component was slightly offset in time and amounted to .014 inches.

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San Antonio, Carrizozo, Tularosa, Elephant Butte

The only other station at which earth or air wave motions were large enough to record on the seismograph was at San Antonio at a distance of 28 miles, where both were recorded. The maximum motion from the ground wave was .002 inches, and motion produced in the recording location by the air wave was also .002 inches. Such displacements are less by a factor of 50 to 100 than any necessary to produce even minor damage in the form of small plaster cracks. They are less by a factor of 2 to 3 than vibrations caused by ordinary use of a house, such as walking across floors and slamming doors. In other words, there was absolutely no chance whatever of causing structural damage in the vicinity of the July 16, 1945 test either by earth-borne or air-borne waves. At Tularosa, from which a number of reports of an earthquake emanated following the 100-ton shot of May 7, the air wave on July 16 was barely perceptible to me, though I was listening carefully for it. It was like the greatly attenuated thud from the firing of a distant gun. According to reports, the air wave of July 16 apparently was most marked in the direction of San Antonio and Socorro, but our control point at San Antonio indicates that it was well below damaging magnitude.

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Figure 1

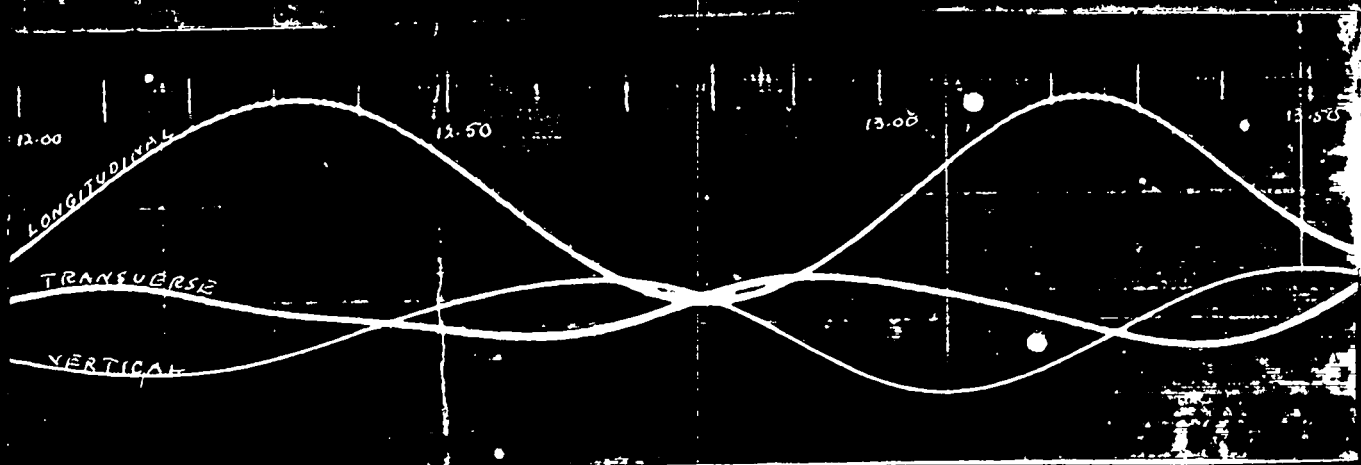


Figure 3

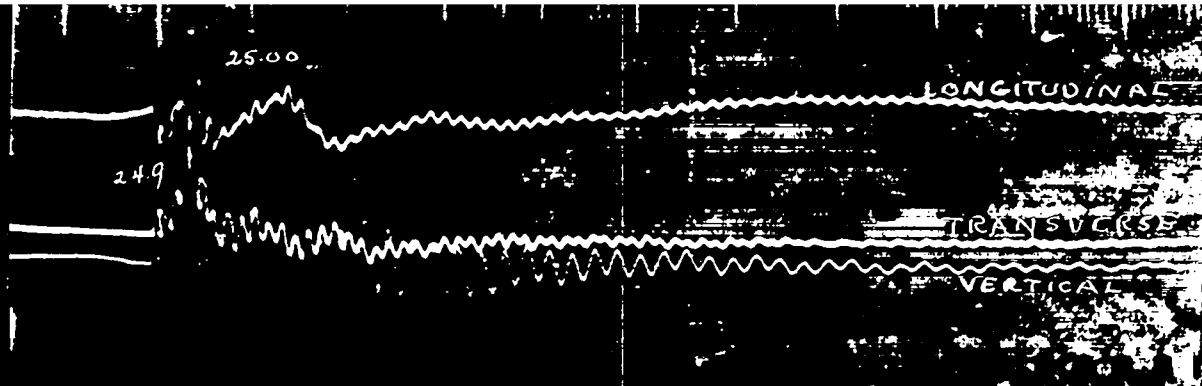


Figure 3

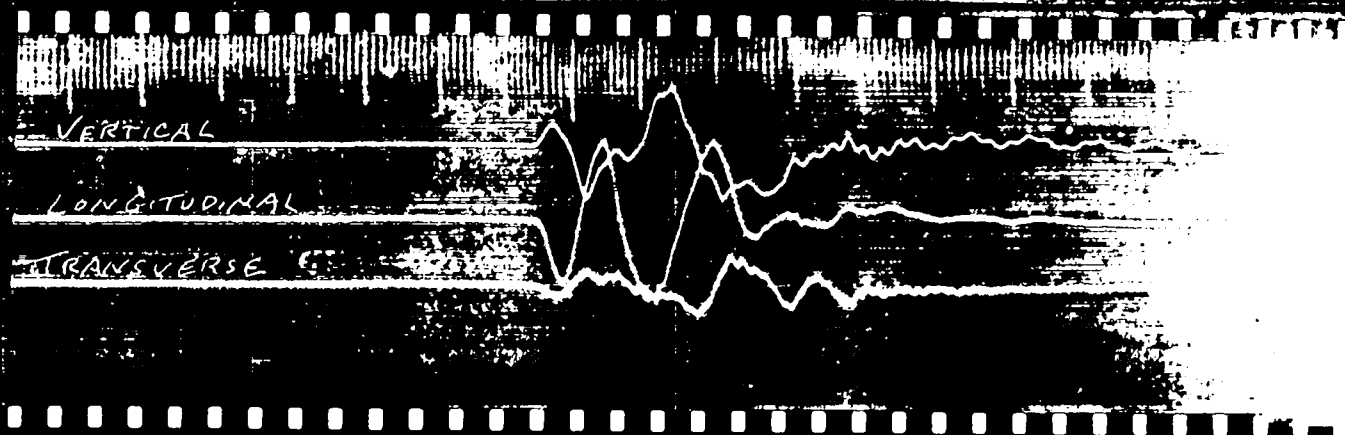


Figure 4

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