Resistance in the Midst of the Anthropocene: The Rise and Fall of Artificial Earthquakes at the Rocky Mountain Arsenal, 1962–1966

Justin Whitney

Summary

Between 1962 and 1967, the Denver Metropolitan Area (DMA) experienced over 1,500 earthquakes. While the area had previously witnessed seismic events, this was extremely uncharacteristic. Investigating geologists soon discovered the source: a 12,045-foot injection disposal well at the Rocky Mountain Arsenal (RMA). The U.S. federal government ceased pumping chemical byproducts into the lithosphere due to protests of concerned residents. This story not only highlights the way a small group of human beings acted as a geological force, it speaks to the significance of local resistance in the age of the Anthropocene.

From World War II through the 1970s, the U.S. Army Chemical Corps and a handful of private companies produced a range of chemical weapons at the Rocky Mountain Arsenal (RMA). Located less than fifteen miles to the northeast of Denver, Colorado, the RMA was one of the largest chemical weapons manufacturing sites in U.S. history. In the early 1980s the U.S. government declared the RMA a contaminated landscape (informally called a Superfund site) within the purview of the Comprehensive Environmental Response, Compensation and Liability Act. Due to the unanticipated return of various species following the closure of the RMA, the U.S. Fish and Wildlife Service took interest in the land. President George H.W. Bush eventually signed the Rocky Mountain Arsenal National Wildlife Refuge (RMANWF) Act, which pledged to assist in the return of iconic animals such as bison and bald eagles. While this is a well-known, if unusual, conservation story, the RMA is also an important site in the seismic history of the United States.

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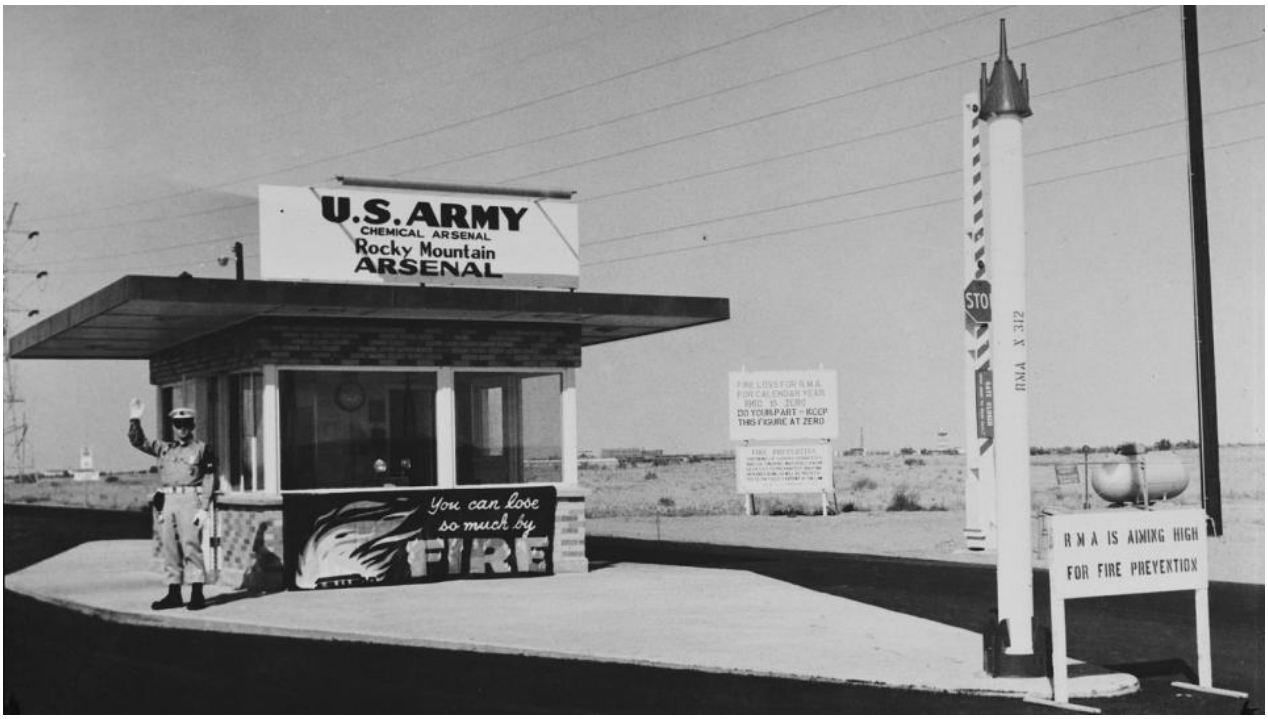
In 2007, Bison were introduced into the Rocky Mountain Arsenal National Wildlife Refuge.

Photograph by Hans Watson.
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Since the emergence of the field of environmental history, environmental historians have utilized concepts from the physical sciences. One that has caught the attention of many historians is the Anthropocene, which is based on Paul Crutzen and Eugene Stoermer's hypothesis from 2000. According to the atmospheric chemist and the diatom scientist, the planet has entered a new geological age due to humanity's unprecedented modification of the atmosphere, biosphere, and hydrosphere. While this intellectual discourse has become rather robust in recent years, scholars have largely neglected to analyze how people have experienced, let alone resisted, the materialization of the Anthropocene at the local level. Such cases are important because they highlight the way people throughout the world have actually encountered the so-called new geological age.

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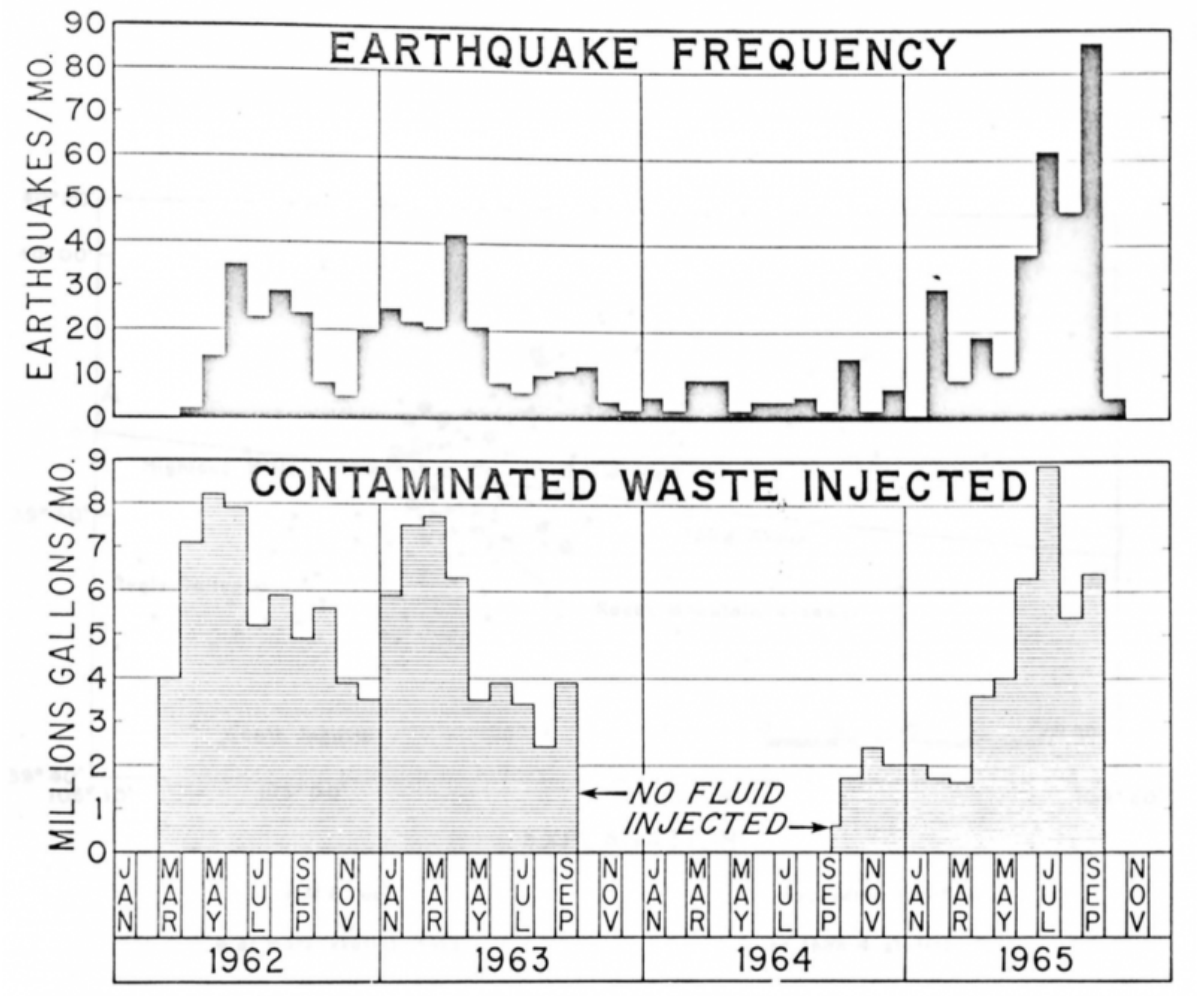
A 1960 photograph of an unnamed guard at the south entrance of the Rocky Mountain Arsenal. Signs encourage visitors to do their part to prevent wildfires.

Unknown photographer, c. 1960.
Courtesy of Library of Congress Prints and Photographs Division.
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The rise and fall of artificial earthquakes at the RMA serves as a useful example. In 1961, the U.S. Army drilled a two-mile-deep disposal well at the RMA. Officials believed the injection of millions of gallons of chemical byproducts into the ground served as a safe alternative to the prevailing evaporation method. However, the action drastically altered the subterranean environment. Within less than a year the Denver Metropolitan Area, a region not known for earthquakes, became one of the most seismically active regions in the nation. Between 1962 and 1967, the U.S. Geological Survey (USGS) recorded over 1,500 earthquakes along the Derby Fault, including a number of 5.0 magnitude earthquakes that caused damage to the DMA. Though residents escaped injuries, the earthquakes took a financial toll. According to the Colorado Geological Survey (CGS), a lone 4.8 magnitude earthquake, on 9 August 1967 cost over 1 million U.S. dollars in property damages.

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In 1966, David Evans published a report linking the earthquakes with the Rocky Mountain Arsenal. To many people in the Denver Metropolitan Area this evidence solidified the correlation.

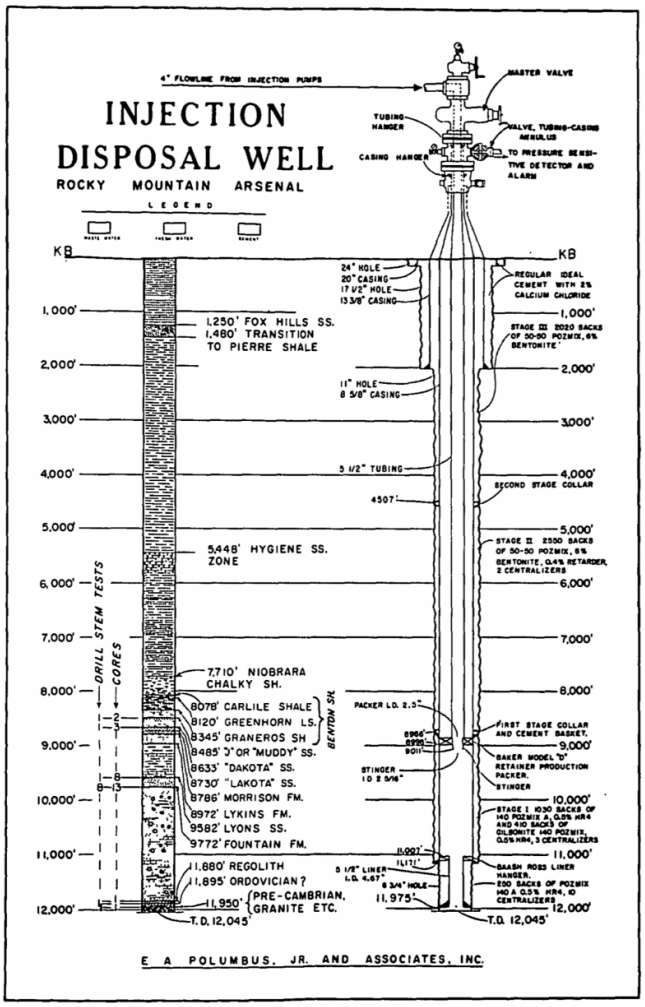
Originally published in Evans, "The Denver Area Earthquakes and the Rocky Mountain Arsenal Disposal Well," 27.

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Three individuals were responsible for initially linking the earthquakes to the RMA disposal well: Yung-Liang Wang, Joseph V. Downey, and David Evans. Due to the uncharacteristic outbreak the USGS established additional seismograph stations throughout the DMA. While in graduate school at the Colorado School of Mines, Wang used the new data to locate the specific location of the earthquakes. Meanwhile, Downey, as the director of Denver's Regis College Seismological Observatory, was one of the first individuals to propose a correlation between the RMA disposal well and the earthquakes. Evans, who was a local geologist, expanded on the insights of Wang and Downey and publicly declared that the RMA's disposal well triggered the earthquakes in a 1966 article in The *Mountain Geologist*.

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The 12,045-foot (3,671-meter) RMA injection disposal well was considered revolutionary for the time. In 1961, it was one of the deepest wells in the United States.

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Though Evans's hypothesis was met with skepticism from the scientific community, many DMA residents took an interest in his theory due to their lived experience of the earthquakes. In addition to the local media, newspapers such as the *Los Angeles Times* covered their experiences and broadcast their concerns. This publicity led U.S. Representative Roy McVicker (Democrat of Colorado) to hold a public hearing on the source of the earthquakes and subsequently called for a federal investigation. To the delight of the DMA community, the U.S. Army ceased injecting chemical byproducts into the lithosphere in February 1966. One month later the USGS released a report that confirmed the reasons for the outbreak of artificial earthquakes at the RMA.

As artificial earthquakes are on the rise throughout the United States due to fracking and wastewater injection, Americans would do well to be mindful of this story in the early twenty-first century. The RMA earthquakes

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reveal one of the first instances in which the United States experienced induced seismicity. Yet it did not last long because the residents of the DMA demarcated the triggering of artificial earthquakes as a line that human beings should not transgress. While it was one thing for the federal government to produce chemical weapons in Denver's backyard, it was unacceptable to allow the army to act as a geological force, on a par with the most powerful natural hazards on earth. This demonstrates that Americans do in fact have the ability to resist the U.S. government in the midst of the Anthropocene.

Table 1. COLORADO EARTHQUAKES, MAGNITUDE 3 AND LARGER
(From U. S. Coast and Geodetic Survey Reports)

No.	Year	Mon.	Day	Greenwich Mean Time Hour	Min.	Sec.	**Longitude (N)	Latitude (W)	Depth (km)	Mag-nitude	Felt Area
1.	1882	Nov.	7				?	?	?	?	Denver, Louisville, Georgetown and S. E. Wyoming
2.	1960	Oct.	11	01	05	30.5	38.3°	107.6°		5.5	Cimarron, Lake City, Montrose, Ophir, Ouray, Placerville, Powderhorn, Ridgeway, Telluride
3.	1961	Nov.	27	00	55	45.7	39.0°	106.1°	(33)	?	Fairplay, Hartsel, Leadville, Jefferson, Buena Vista, Alma
4.	1962	June	18	00	46	05.0	?	?	?	3.1	Denver, Derby, Henderson
5.	1962	Aug.	7	00	51	00.0	?	?	?	3.0	Denver, Derby, Henderson
6.	1962	Dec.	4	17	49	59.4	39.8°	104.7°	(33)	3.6	Denver, Jefferson, Adams
7.	1962	Dec.	5	13	48	00.4	39.9°	104.6°	(33)	3.8	Denver, Pueblo
8.	1963	Jan.	30	23	05	09.6	39.8°	104.6°	(33)	3.2	Denver, Boulder
9.	1963	April	8	00	03	59.1	39.6°	104.9°	(33)	3.2	Denver, Derby, Henderson
10.	1963	April	24	22	29	35.7	39.7°	104.8°	(33)	3.2	Denver, Derby, Henderson
11.	1963	May	25	10	44	38.1	39.8°	104.7°	(33)	3.5	Denver, Derby, Henderson
*12.	1963	June	5	00	13	56.6	39°52.5'	104°55.5'	2.6	3.0	Denver, Derby, Henderson
13.	1963	July	2	08	02	54.1	39.8°	104.7°	(15)	3.0	Denver, Boulder
14.	1963	July	28	13	18	47.0	?	?	?	3.1	Denver, Derby, Henderson
*15.	1965	Jan.	5	01	05	31.2	39°54.7'	105°15.8'	15.6	?	Western Denver, Louisville
16.	1965	Feb.	16	20	17	54.0	39.9°	105.1°	5	4.6	Western Denver, Louisville
*17.	1965	Feb.	16	22	21	46.9	39°52.4'	104°55.2'	8.3	3.7	Western Denver, Louisville
18.	1965	July	31	13***	41	43.0	39.7°	104.9°	5	4.6	Western Denver, Louisville
19.	1965	Sept.	14	22***	46	24.0	39.9°	104.6°	5	4.7	Western Denver, Louisville
20.	1965	Sept.	29	18***	59	56.0	39.8°	105.1°	5	4.7	Western Denver, Louisville
21.	1965	Sept.	29	19***	20	41.0	39.7°	104.9°	5	4.6	Western Denver, Louisville

* Determined from local seismogram data.
** For Mountain Standard Time, subtract 7 hours.
*** For Mountain Daylight Savings Time, subtract 6 hours.

(Wang, 1965, with additions)

This image highlights the major earthquakes within the Denver Metropolitan Area through 1965.

Originally published in Evans, "The Denver Area Earthquakes and the Rocky Mountain Arsenal Disposal Well," 29.

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