

LAST WORD SOCIETY

John I. Thornton,¹ D. Crim. and Jill M. Shirokawa,¹ B.S.

A Trajectory Analysis of Billy Dixon's Long Shot

REFERENCE: Thornton, J. I. and Shirokawa, J. M., "A Trajectory Analysis of Billy Dixon's Long Shot," *Journal of Forensic Sciences*, JFSCA, Vol. 34, No. 4, July 1989, pp. 1037-1041.

ABSTRACT: At the Second Battle of Adobe Walls, in June 1874, Billy Dixon shot an Indian at a range of 1538 yd, give or take just a few. A computer analysis of this trajectory indicates that the bullet drop would have been 3823.8 in., the time of flight 4.838 s, and the windage adjustment would have been 337.8 in.

KEYWORDS: forensic science, ballistics, historical background, computers

In June 1874, a mixed group of Comanche, Kiowa, and Arapahoe attacked a trading post in the Texas Panhandle. This engagement is known as the Second Battle of Adobe Walls.² A full account of the battle has been recently given by Baker and Harrison [1]. The traders and buffalo hunters at Adobe Walls were attacked intermittently for 3 days, after which the Indians withdrew. The Indians were under the leadership of the Comanche, Quanah Parker.³ During the battle, Quanah was shot in the side, which may have something to do with his subsequent decision to withdraw. Among the 28 white men (and 1 white woman) at the post were William Barclay ("Bat") Masterson and a 23-year-old buffalo hunter named Billy Dixon.⁴

On the third day of the engagement, Billy Dixon shot an Indian at a long distance, most frequently and persistently reported as 1538 yd [2]. It was a phenomenal shot for a buffalo rifle with iron sights. The present work is an attempt to review aspects of the trajectory of this shot by means of the TRAG1P [3] computer program.

For the shot, Dixon used a Sharps "Big 50," that is, a .50-90 Sharps, which had just been

Received for publication 15 Oct. 1988; accepted for publication 31 Oct. 1988.

¹Professor and graduate student, respectively, Forensic Science Group, Department of Biomedical and Environmental Health Sciences, University of California, Berkeley, CA.

²A previous battle, quite logically called the *First* Battle of Adobe Walls, was fought in the fall of 1864 at a site approximately 1.2 miles south of the 1874 engagement. For the previous battle, the Army detachment was under the command of Colonel Christopher ("Kit") Carson. The Indians fared no better in the first battle than in the second.

³Parker is obviously not an Indian name. Quanah was half white, although in outlook he was entirely Indian. His mother, Cynthia Ann Parker, had been captured as a little girl and raised as an Indian.

⁴Following the Second Battle of Adobe Walls, Billy Dixon served as a civilian scout for General Nelson A. Miles. On 10 Sept. 1874, Billy, four soldiers, and one other civilian scout were attacked by a overwhelming number of Comanches. Billy survived this battle, known as the Battle of Buffalo Wallow, receiving one wound to the calf of his leg, but with several bullets passing through his shirt. For his part in this engagement, he received the Congressional Medal of Honor. His heroism is beyond cavil; in counterpoise, however, several people who knew him described him as coarse and mean.

introduced. The trajectory of this cartridge, as will be seen in the discussion below, is vaguely reminiscent of a rainbow. The calculation of a trajectory by the TRAGIP program requires several bits of information which were supplied in various fashions:

Cartridge

Billy Dixon's autobiography⁵ has the rifle as a Sharps "Big 50" belonging to the saloon-keeper, James Hanrahan. Dixon is so explicit in his account of how he came by this weapon as to leave no doubt as to the caliber [4]. Dixon's own rifle was a .44-90, which he had just purchased to replace a "Big 50" Sharps that he had lost, but he was very clear that he didn't use his own rifle for the long shot. The present writers are inclined to believe him: Dixon was a buffalo hunter, and presumably knew something about buffalo guns. No one would agonize even a moment over the caliber of the rifle but for the statement by Barnes, in *Cartridges of the World* [5], that the .50-90 was introduced in 1875, which, if true, would mean that the .50-90 was not used at Adobe Walls. Fortunately, however, it is possible, even at this time, to resolve this issue.⁶

Range

No factor in this trajectory analysis is more difficult to establish than the range, given the confusion in the literature, and no factor is more important in the reconstruction of the trajectory. One of the first written accounts after the battle, that of the buffalo hunter Willis Skelton Glenn, gave the range as 1400 yd [7]. In the first edition of Dixon's autobiography the range is given as 1200 yards [8], but in the second edition [4, p. 180] the range has been revised in the *text* upward to seven-eighths of a mile, of 1538 yd.⁷ The topographical map of the area, taken together with Dixon's autobiography, helps immeasurably in the clarification of this issue. Dixon's account of the shot has the Indian on top of the 100-ft-high bluff to the East. This is supported by other eyewitness accounts [7]. Earlier in his autobiography [4, p. 150], he describes Adobe Walls in the following manner:

East of Adobe Walls lay the open valley of Walls Creek, terminating in a growth of willows, cottonwoods, hackberry and chinaberry that fringed this stream, on the other side of which, at a distance of about twelve hundred yards from the Myers & Leonards' store, stood a butte-like hill of considerable height, with a more or less level bench near the summit . . .

Dixon apparently shot the Indian on the top of the bluff, and he had previously estimated the distance *to the top of the bluff* as 1200 yd, a distance that we now know to be in error. *The current topographic map shows the distance from the Adobe Walls historical marker to the top of the 2781-ft-high bluff to be very close to 1538 yd.* The hide hunter Glenn, giving the

⁵Dixon died of pneumonia in March 1913. In January 1913, his wife, Olive King Dixon, began to take down in longhand her husband's words. Mrs. Dixon was a literate schoolteacher, and with the aid of an editor, Frederick S. Barde, the work appeared in 1914 in an edited and polished version. A second edition appeared in 1927; this edition is substantially the same as the first edition, *but states a longer range for Dixon's long shot.* The 1927 edition was reprinted in 1987. In all of these editions, Dixon's words are in the form of first person singular. It is a reasonable inference to make that between 1914 and 1927 the distance was determined by either measurement or by reference to a detailed map of the area.

⁶The .50-90 Sharps cartridge was introduced along with the Sharps Model 1874 rifle, in 1874 [6]. The note in Barnes is misleading, but the mistake can be attributed to the form in which the information is presented. When Barnes says that the .50-90 first appears in the 1875 Sharps catalog, he is entirely correct. Equally true and more relevant to our discussion is the fact that there is no such thing as an 1874 Sharps catalog [6, p. 96]. Clearly, the .50-90 was represented at the battle. Excavations of the Adobe Walls site from 1975 to 1980 revealed ten expended .50-90 cartridge cases [1, p. 195].

⁷Curiously, the table of contents of the 1927 edition still carries the range as 1200 yd.

range as 1400 yd, apparently was estimating the distance to the top of the bluff (as had Dixon) and was closer to the actual range. The figure of 1538 yd, as adopted by Olive Dixon in the second edition of the autobiography (but which was not corrected in the table of contents) is a very reasonable distance as read off the 7.5-min topographical map [9] and is a figure that has had the benefit of an actual survey. This distance of 1538 yd would represent the distance as the crow flies, although the crow would fly a flatter trajectory than did the .50-90 Sharps. Contemporary accounts [10–12] are consistent in giving the range as 1538 yd.⁸

Elevation

The elevation of Adobe Walls is 2685 ft above sea level, as determined from a U.S. Geological Survey topographical map [9].

Temperature

With all the whooping and scalping going on outside, the white men bottled up inside the trading post (four of whom were killed in the battle) neglected to record the temperature on June 28th. However, the mean daytime maximum temperature for June (for nearby Amarillo) as given in *The Weather Almanac* [13] is 88.2°F, and this figure was used for the principal computer simulation of the trajectory.

Height of Sight above Bore

The height of the sight above the center of the bore is taken here as 0.630 in. (one half of the 0.509-in. bullet diameter plus 0.375-in. barrel and iron sight).

Bullet Coefficient

The bullet coefficient was computed as 0.523 by the method given by Hatcher [14].⁹

Bullet Weight and Muzzle Velocity

This was determined from Barnes [5]. The bullet weight is taken as 465 grains and the muzzle velocity as 1320 fps.

⁸There is still another obscurely reported distance, that of 1028 yd, ("Adobe Walls Celebration Plans Advancing Rapidly as June 27 Approaches," *Amarillo Daily News*, 8 June 1924, *Western Weekly Supplement*, p. 10, cited in *Ref 1* at p. 315), but that distance does not square with the eyewitness accounts. A distance of 1028 yd would have the Indian in *front* of the bluff to the East of Adobe Walls, whereas all of the participants seem to be in accord that the Indian was on the skyline on *top* of the bluff.

⁹The .50-90 Sharps might be listed in some table of Bullet Coefficients, but none that the present writers know about. (Nor, for that matter, do the present writers expect to have to look this up again). The DuPont nomographs devised by Edgar Bugless and Wallace H. Coxe permit the bullet coefficient to be determined for this cartridge, but the projection of lines on the nomographs are just barely within the scope of the graphs. Additionally, the reading of the ballistics coefficient is in the compressed area of the logarithmic scale, and can be read as 0.6, to only one significant figure. The coefficient may be computed, however, as $C = w/id^2$, where w is the weight of the projectile in pounds, d is the diameter of the projectile, and i is the form factor. The form factor of 0.5 is given by the Bugless and Coxe charts, which also appear in *Hatcher's Notebook* [14].

Wind

The Weather Almanac [13] gives the prevailing June wind (for nearby Amarillo) as being from the South with a mean velocity of 14.3 mph.¹⁰ Billy Dixon's shot was toward a bluff to the east of Adobe Walls. His shot therefore was the most difficult one imaginable from the standpoint of deflection—directly across the wind.

Using these data, the TRAGIP trajectory analysis for 1538 yd delivers the following:

Muzzle velocity: 1320 ft/s
 Range: 1538 yd
 Remaining velocity: 781 ft/s
 Remaining energy: 630 ft · lb
 Time of flight: 4.838 s
 Total drop: 3823.8 in.
 Maximum height above sight line: 1137.2 in.
 Elevation required: 248.7 MOA
 Deflection for 14.3-mph crosswind: 337.8 in.

We are now in a position to assume other values for temperature, wind, and range—the three variables that are the most difficult to resurrect. If one were to bother plotting the bullet drop against temperature (and the present authors did bother), one would see a linear relationship in which the 1538-yd drop at 70° would be 3869.1 in., and 3774.4 in. for 110°. The regression equation for this relationship is $\text{Bullet Drop} = 3840.43 - 2.05(\text{temperature})$; the regression equation is included so that the drop at any given temperature may be calculated.¹¹ For wind deflection at 1538 yd, a deflection of 23.62 in. would accrue for each mile per hour of crosswind, and so, for example, for a 10-mph crosswind the deflection would be 236.2 in. (Although the deflection of 337.8 in. for a 14.3-mph crosswind seems a great distance, it should be recognized that at the range of 1538 yd, this deflection is only 21 min of arc). At 88.2°, the bullet drop at the other distances mentioned would be 2153.1 in. at 1200 yd, 1511.4 in. at 1028 yd, and 3072.6 in. at 1400 yd.

At 1538 yd, the remaining velocity of 781 ft/s and the remaining energy of 630 ft · lb is considerably in excess of that required to penetrate human skin, or, for that matter, even human bone [15]. The analysis described above indicates clearly that the .50-90 Sharps could indeed carry to that distance and still inflict a lethal wound. The trajectory is believable. Still, with a bullet drop in excess of 318 ft and “Kentucky windage” in excess of 28 ft, it is unlikely that Billy Dixon could have done it twice in a row.

References

- [1] Baker, T. L. and Harrison, B. L., *Adobe Walls*, Texas A&M University Press, College Station, TX, 1986.
- [2] Dykes, J. C., “The Second Battle of Adobe Walls,” *Great Western Indian Fights*, B. W. Allred, J. C. Dykes, F. Goodwyn, and D. H. Simms, Eds., University of Nebraska Press, Lincoln, 1960, p. 213.
- [3] Davis, W. C., *TRAGIP PROGRAM*, Tioga Engineering Co., 13 Cone St., Wellsboro, PA, 16901, PAB Software, P.O. Box 15397, Ft. Wayne, IN, 46885.

¹⁰Those of us who have spent any time at Air Force installations around Amarillo will inevitably suspect, on purely subjective grounds, that *The Weather Almanac* is in error on the low side. However, there is some independent verification of the wind from the Indian side of the battle. In a 1935 interview, Cohaya, an Indian survivor (of both bullets and years), said that “suddenly, and without warning or apparent cause, one of the warriors fell from his horse dead. The wind was blowing and the hide man's rifle was fired from such a distance that the braves had been unable to hear the report when it fired.” (Co-hay-ya to Wilbur Sturtevant Nye, interview, 18 March 1935, cited in Ref 1, note 55, Chapter 3, p. 315).

¹¹The maximum recorded temperature for June in Amarillo is 108°F.

- [4] Dixon, Olive K., *Life of "Billy" Dixon*, 2nd ed. (facsimile reproduction of 1927 edition), State House Press, Austin, 1987, p. 166.
- [5] Barnes, F. C., *Cartridges of the World*, 3rd ed., Digest Books, Northfield, IL, 1972, p. 115.
- [6] Smith, W. O., *The Sharps Rifle*, William Morrow & Co., New York, 1943, p. 43.
- [7] Glenn, W. S., "Shelton [sic] Glenn Buffalo Hunt Manuscript," Special Collections, University of Texas at El Paso, El Paso, TX (cited in Ref 1 at p. 351).
- [8] Dixon, O. K., *Life and Adventures of "Billy" Dixon of Adobe Walls, Texas Panhandle*, S. Barde, Ed., Co-Operative Publishing Co., Guthrie, OK, 1914.
- [9] "U.S. Geological Survey Topographical Map, Adobe Creek, TX, N3552.5-W10107.5," U.S. Geological Society, 1971.
- [10] Syers, E., "History's Greatest Shot by Indian Fighter Dixon," *San Antonio Evening News*, 8 Nov. 1963, Sect. B, p. 7.
- [11] Syers, E., "Adobe Walls Site of Historic Single Long Range Shot," *San Antonio Express*, 1 Dec. 1971, Sect. B, p. 8.
- [12] Keck, N. and Albers, K., "Mile-Long Shot Ends Indian Siege," *Amarillo Daily News*, Amarillo, TX, 18 Aug. 1980.
- [13] *The Weather Almanac*, J. A. Ruffner and F. E. Bair, Eds., Gale Research Co., Detroit, MI, 1987, p. 731.
- [14] Hatcher, J. S., *Hatcher's Notebook*, 3rd ed., Stackpole, Harrisburg, PA, 1966, p. 574.
- [15] Mattoo, B. N., "Casualty Criteria for Wounds from Firearms with Special Reference to Shot Penetration," *Journal of Forensic Sciences*, Vol. 14, No. 1, Jan. 1969, p. 120.

Address requests for reprints or additional information to
Dr. John I. Thornton
Forensic Science Group
Department of Biomedical and Environmental Health Sciences
University of California
Berkeley, CA 94720