# Meriwether Lewis's Lead Powder Canisters

S. K. Wier

Boulder, Colorado

On August 6, 1805, the men of the Lewis and Clark Expedition were struggling to advance their dugout canoes up the shallow but swift waters of the Jefferson River in what is now western Montana. In his journal that evening Captain Meriwether Lewis described a serious accident.

> I walked down to the point where I waited their return. on their arrival found that two other canoes had filled with water and wet their cargoes completely. Whitehouse had been thrown out of one of the canoes as she swing in a rapid current and the canoe had rubed him and pressed him to the bottom as she passed over him and had the water been 2 inches shallower must inevitably have crushed him to death. our parched meal, corn, Indian preasents, and a great part of our most valuable stores were wet and much damaged on this ocasion. to examine, dry and arrange our stores was the first object; we therefore passed over to the lard. side opposite to the entrance of the rapid fork where there was a large gravly bar that answered our purposes; ... and unloaded all our canoes and opened and exposed to dry such articles as had been wet. a part of the load of each canoe consisted of the leaden canestirs of powder which were not in least injured, tho' some of them had remained upwards of an hour under water. about 20 lbs. of powder which we had in a tight Keg or at l[e]ast one which we thought sufficiently so got wet and intirely spoiled. this would have been the case with the other had it not have been for the expedient which I had fallen on of securing the powder by means of the lead having the latter formed into canesters which were filled with the necessary proportion of poder to discharge the lead when used, and those canesters well secured with corks and wax. in this country the air is so pure and dry that any vessel however well seasoned the timber may be will give way or shrink unless it is kept full of some liquid.[1]

[1]Gary E. Moulton, ed., *The Journals of the Lewis & Clark Expedition*, 13 volumes (Lincoln: University of Nebraska Press, 1983-2001), Vol. V, p. 53. All quotations from journal entries in the ensuing text are from

The expedition had long since exhausted most of their preserved foods and were relying on hunters to bring in game every day for food. If deprived of gunpowder, or lead to make bullets, they would face serious hardships, perhaps threatening the success of the expedition or even the survival of the party.

The "leaden canestirs" saved the gunpowder on more than one occasion. In a dramatic incident just a few weeks later, during the strenuous crossing of the Bitterroot Mountains (Lewis, September 19, 1805):

> ...the road was excessively dangerous along this creek being a narow rockey path generally on the side of steep precipice, from which in many places if ether man or horse were precipitated they would inevitably be dashed in pieces. Fraziers horse fell from this road in the evening, and roled with his load near a hundred yards into the Creek. we all expected that the horse was killed but to our astonishment when the load was taken off him he arose to his feet & appeared to be but little injured, in 20 minutes he proceeded with his load. this was the most wonderfull escape I ever witnessed, the hill down which he roled was almost perpendicular and broken by large irregular and broken rocks.

Private Joseph Whitehouse's account adds details relating to the powder canisters:

> ... descended a mountain about four Miles, and arrived at a Creek, whose course run east, we pursued our way up the Creek on a bad piece of Road, some places running along close under the Mountain; which is high & steep on both sides of the Creek, One of our horses fell backwards, & rolled about 100 feet down a steep solid Rock, and dashed against a Rock, in the Creek with his load; which was Ammunition; The Powder, being in leaden Cannisters, was not damaged, nor the horse killed, but much hurt.— We proceeded on ...

Later during the winter at Fort Clatsop on the Pacific coast, the men were taking stock of the remaining supplies (Clark, February 1, 1806):

> ..To day we opened and examined all our Ammunition, which has been Secured in leaden Canistirs. we found twenty Sevin of the best Rifle powder, 4 of Common rifle, 3 of Glaize and one of Musquet powder in good order, perfectly as dry as when first put in the Canisters, altho the whole of it from various accidince have been for hours under the water. these Cannisters Contain 4 pounds of powder each and 8 of Lead. had it not been for that happy expedient which Capt Lewis devised of securing the powder by means of the Lead, we Should have found great dificuelty in keeping dry powder untill this time—; those Cannisters which had been acidently brused and cracked, one which was carelessly Stoped, and a fifth which had been penetrated with a nail; were wet and damaged; those we gave to the men to Dry; however exclusive of those 5 we have an abundant Stock to last us back; and we always take Care to put a purpotion of it in each canoe, to the end that Should one Canoe or more be lost we Should Still not be entirely bereft of ammunition, which is now our only hope for Subsistance and defences in the rout of 4,000 miles through a Country exclusively inhabited by Indians.

And there is another specific report in the journals of the lead canisters saving the gunpowder from a soaking (Lewis, May 4 1806):

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Moulton, by date, unless otherwise indicated.

> ... the hills of the creek which we decended this morning are high and in most parts rocky and abrupt. one of our pack horses sliped from one of those hights and fell into the creek with it's load consisting principally of ammunition but fortunately neith the horse nor load suffered any material injury. the amunition being secured in canesters the water did not effect it.— after dinner we continued our rout up the West side of the river ....

There were other occasions when the powder canisters were splashed with waves, doused by rain, and dumped into rivers.

In 1800 gunpowder usually was supplied in wooden kegs. One "keg" of the time held 25 pounds of gunpowder, a half-keg held 12 1/2 pounds, a quarter-keg held 6 1/4 pounds. Some 5 and 20 pound kegs were used, and there were barrels (holding 100 pounds, or more) and "half barrels" (50 pounds).[2] The kegs often were made with an interior coating of tar to resist water, but out west wooden objects brought from the eastern United States shrank and split in the dry air. Lewis's lead canisters, stoppered with corks and sealed with wax, were watertight, and dry air meant nothing to them. The lead canister walls, although fairly soft for metal and easily "brused," were resistant to splitting open in accidents.

No canisters from the expedition are known to survive, although at least one may still lie buried on the trail. What more can we infer from the records of the expedition about Lewis's lead powder canisters? Lewis's journal entry of February 1, 1806 relates that the canisters were made with eight pounds of lead. This matches records of supplies obtained in Philadelphia in May of 1803. The "Invoice of Articles received from the Arsenal for the use of Capt. Lewis," dated May 18th 1803, includes "420 lbs Sheet lead."[3] Note that the invoice specifies sheet lead, not lead pipe, and not lead ingots for castings. On May 25, 1803, Israel Whelan, the purveyor of public supplies, paid George Ludlum, a plumber at 96 South Second Street, $26.00 for "Making 52 lead Cannisters for Powder."[4] Using the 420 pounds of sheet lead, that amounts to a trifle more than eight pounds of lead per canister, confirming Lewis's description. As a practical matter there is no excess lead for waste in assembly, so perhaps the finished canisters used slightly less than 8 pounds of lead apiece.

Both Clark's and Lewis's journal entries for February 1 1806 relate that the canisters held four pounds of gun powder. From all these data – the fact that the canisters were made of lead, the weight of the lead used in each canister, and the capacity – it is possible to calculate dimensions for lead canisters matching Lewis's criteria. It is not possible to find one single design since we do not know the shape of the canisters or the thickness of the lead, but some reasonable assumptions converge the possible designs on a general pattern.

The surviving evidence gives no clue to the shape of the canisters. A reasonable assumption is that they were circular cylinders. At that time tea was sold in "canisters" that were tin cylinders. In military terminology of 1800, "canister" had the special meaning of case shot, a cylindrical container holding a large number of bullets, sized to fit the bore of a cannon. So

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2 personal communications, Ted Bayck (author of *Gun Powder Cans and Kegs*, Maynardsville TN: Rowe Publications, 1998), and Will Adye-White.

3 Donald Jackson , ed., *Letters of the Lewis and Clark Expedition and Related Documents*, *1783-1854*, 2 volumes (Urbana: University of Illinois Press, 2nd ed., 1978), Vol. 1, p 98.

4 Ibid., p. 80.

the word canister in 1800 carried a suggestion of cylindrical shape. A cylinder is a simple shape to make in sheet metal. A lead cylindrical canister requires only three pieces of lead and three solder joints, one at each edge and a seam along a side, and it is about as strong a vessel as you can make with sheet lead. Boxes with angles require more pieces and more joints, and have flat sides prone to dents. Simply for purposes of obtaining a rough idea what the canisters may have been like, I calculated the dimensions of cylindrical canisters, with flat tops and bottoms, made of sheet lead, which fit Lewis's weight and capacity values.

There is no evidence about the thickness of lead sheet used to make the canisters. I expected that the canisters might have fairly thick walls, something like a finger thickness perhaps. However that is not the case. Lead is a very dense material - a cubic foot of pure lead weighs some 708 pounds - and even small pieces are surprisingly heavy. Canisters fitting Lewis's description cannot be made if the lead sheet is thicker than 0.141 inches, just a little more than one eighth of an inch. Using thicker material always makes a canister, of any size or shape, weigh more than eight pounds before the capacity is large enough to hold four pounds of powder. It would be helpful if surviving American objects of the period assembled from pieces of sheet lead could be examined for a guide to standards of the time, if any; plumbing and church roofing sheet lead comes to mind. For the volume of the desired gunpowder capacity of four pounds I used 122 cubic inches which is valid for modern black powder, FFF or rifle grade. Black powder made in 1803 may differ from that figure some, but probably not much.

Sheets of pure lead one-eighth of an inch thick are commercially available today. It is a useful thickness, and may have been available in 1803 as well. For one-eighth inch sheet lead, there are only two cylindrical canisters that use exactly eight pounds of lead and hold exactly four pounds of powder, canisters 1 and 2 in Table 1. Canister 2, with a height of 3.26 inches and a diameter of 7.44 inches, is less practical than canister 1 because the large flat end surfaces easily could be crushed. Canister 1 is taller than wide and fairly easy to carry, even in one hand. Canister 1 is a plausible design for the expedition canisters.

If a slightly thicker lead is used, 0.141 inches thick in place of 0.125 inch, the most compact possible design is found (canister 3), where both the outside diameter and height are 5.66 inches. This canister has exactly eight pounds of lead and holds 4 pounds of powder. To verify the calculations, I made examples of canister designs 1 and 3, shown in Figure 1.

Table 1. External dimensions, wall thickness, and internal capacity of black powder, for cylindrical canisters made with eight pounds of sheet lead.

| ***Canister*** | ***diameter*** | ***height*** | ***wall thickness*** | ***capacity*** |
|---|---|---|---|---|
| 1 | 4.16 inches | 10.42 inches | 0.125 inches | 4.00 pounds |
| 2 | 7.44 “ | 3.26 “ | 0.125 “ | 4.00 “ |
| 3 | 5.66 “ | 5.66 “ | 0.141 “ | 4.00 “ |

Canisters 1 and 3 described here may be close to what the expedition used. Canisters with conical or domed tops, and other shapes such as boxes, could also be designed to fit Lewis's description. Compared to cylinders, all other forms are more difficult to make and offer no advantages which I can see. Boxes require thinner lead than cylinders if they are to hold the same volume of powder, they would be weaker than cylinders both because of the thinner walls and the flat sides and sharp angles, and they would be more difficult to make than cylinders. Cylindrical canisters with flat tops make a lot of sense and are plausible, but we simply can not know the exact shape of the expedition canisters or the thickness of the sheet lead, unless records, or an expedition canister, are found.

Figure 1. Lead canisters of patterns 1 and 3, an 18th century powder horn, 0.49 caliber rifle bullets, a bullet mold, a pronghorn leg bone powder measure with a charge of powder for one bullet, and a cast iron ladle used to melt and pour lead in making bullets, all similar to artifacts probably used on the expedition. The canisters' openings are sealed with corks and sealing wax.

One feature Lewis may have included in his canister design is lugs or “ears,” with holes, to tie the canisters with rope in boats, or on horse packs. The expedition records do not mention lugs directly, but there is one suggestive passage, Clark's description of an accident during the descent of the Snake River in dugout canoes, on October 14, 1805:

> ... at this rapid the Canoe a Stern Steared by drewyer Struck a rock turned the men got out on a rock the Stern of the Canoe took in water and She Sunk the men on the rock hel her, a

> number of articles floated all that Could be Cought were taken by 2 of the othr Canoes, Great many articles lost among other things 2 of the mens beding Shot pouches Tomahaws &c. &c. and every article wet of which we have great Cause to lament as all our loose Powder two Canisters, all our roots prepared in the Indian way, and one half of our goods, fortunately the lead canisters which was in the canoe was tied down, otherwise they must have been lost as the canoe turned over we got off the men from the rock toed our canoe on Shore after takeing out all the Stores &c. we Could & put them out to dry ...

"The lead canisters which was in the canoe was tied down." The canisters must have been small, smooth and heavy. Even if carefully tied with tight loops of rope, and secured to something, the motion and shocks incident to canoe travel in whitewater, not to mention turning over and sinking, would tend to cause such canisters to work loose. While making the canisters, adding lugs would be sound idea and very simple to do, using leftover scraps of lead sheet. Again, we do not know, but it is something to consider.

As well as protecting the gunpowder, the lead canisters had a second and equally valuable role. The lead canisters were intended to be melted down to cast into bullets. As a further refinement, Lewis had designed the canisters to provide the correct weight of lead for making the bullets fired by the powder in each canister: the canisters "were filled with the necessary proportion of poder to discharge the lead when used." Each canister held four pounds of powder and provided eight pounds of lead for making bullets. From Clark's note of February 1, 1806 we see that of the canisters surviving then – 35 of the 52 original canisters remained when the expedition was nearly three-fourths complete – only one held musket powder; the remainder contained rifle powder. The expedition rifles appear to have had calibers in the range of 0.49 to 0.54 inches, with corresponding ball sizes near 0.475 and 0.525 inches diameter. Lead balls of those sizes weigh 160 and 216 grains. Half that weight of lead, 80 and 108 grains, are reasonably large hunting charges of black powder for those size rifles. The Charleville pattern musket of the expedition, with a caliber of 0.69 inches, would fire a ball near 0.675 inches weighing 460 grains. Half that weight of powder or 230 grains is too large by a factor of two or three for a musket charge. Both Lewis's statement of "proportion of poder," and the type of powder in the canisters remaining on February 1, 1806, indicate that the expedition was relying primarily on rifles, not muskets.

Also we can use the records of the lead canisters for insight about other powder supplies. If the expedition had used only the 17 expended canisters for ammunition before February 1, 1806, that amounts to some 5600 loads for a 0.50 caliber rifle, about nine shots per day, too few to supply game for a party of 33 or more. They clearly had supplies of powder and lead in addition to the canisters when the expedition began, as we know from other journal entries which mention powder kegs and lead bars. The remaining 35 canisters alone would provide nearly 50 shots per day on the return trip, more than was needed, and reserves of powder and lead had been previously cached along the return route as well. On several occasions during the return journey generous gifts of gunpowder and lead ball were made to Indians, alleviating the shortage of gifts for Indians which was so troublesome on the return journey. Again we see another advantage of Lewis's forethought.

Lewis's lead canisters to store gunpowder were an important aid in the survival and success of

the expedition. He stated (February 1, 1806) that the canisters were "that happy expedient which I devised of securing the powder by means of the lead." How far did he devise them? Did he adapt existing powder containers to the needs of the expedition, improve known containers in important ways, or create the entire concept? It appears that Lewis may have invented the entire lead powder canister concept, including the lead that provided a durable and waterproof container and which also could be used for bullets, plus the design concept that provided the right amount of lead for the powder inside.

There were metal powder containers before 1800 – small, personal, pocket-sized flasks usually made of copper or brass, sometimes covered with leather, used to carry a small amount of powder for a day's hunting by a gentleman. Frontiersmen and military riflemen used powder horns. The first metal containers to store and transport powder were tin. It is not known who came out with the first powder tin. The DuPont company began operations around 1802, and sometime between 1804 and 1815 they sold powder in tin cylindrical canisters.[5] A surviving early DuPont tin powder canister at the Museum of the Fur Trade in Chadron Nebraska is 5 inches tall and 2 ½ inches in diameter. It has a slightly domed lid and a neck or spout soldered on top.[6] No one I have talked to who is familiar with the powder containers of the time, or with artifacts of the fur trade just before the expedition, has encountered lead containers definitely preceding 1803. The absence of any surviving lead powder containers, in any shape, clearly pre-dating 1803, or of any records of them, suggests that lead powder containers were either non-existent before 1803, or so rare as to leave no sign of them today.[7] Lead canisters, and the idea that the container itself could provide bullets for the powder, in the proper proportion of lead and powder, appears to be an invention by Lewis.[8] Unlike Lewis's iron boat frame, this invention was successful, and clearly valuable for the welfare of the expedition.



5 personal communications, Ted Bayck, and Will Adye-White.

6 personal communication, Jim Hanson, Museum of the Fur Trade, Chadron, Nebraska.

7 personal communications: Ted Bayck; Dave Cooper, Grand Portage National Monument; and Jim Hanson. Will Adye-White, "Gunpowder Manufacture in England 1750-1900." in *Arms Collecting*, Vol. 40, No. 2 (May, 2002) pp. 47-52.

8 The author would like to hear from anyone with evidence that Lewis's lead canister concept was used elsewhere after the expedition, or about clear evidence of lead canisters for any use preceding 1803.