

# Experiment in Iron Age Agriculture

## PART TWO

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THE grain storage experiment reported in the Transactions of this Society (Vol. 86, 1967) was continued for a second year to attempt to establish the findings of the previous year's experiment regarding the use of unlined grain pits. Only one small pit (Pit X) had been unlined in which the grain had stored perfectly to the extent of yielding germination figures of 70%. It was decided, therefore, to use one of the larger pits (Pit B) unlined and to re-use Pit X, taking gas samples from the large pit to compare with those from the same pit when lined and to discover whether the grain stored as well in an unlined large pit as opposed to a small one.

On the 25th September, 1966 both the large and the small pits were prepared and filled. The wickerwork, now much rotted, was removed from Pit B and the sides were cleaned and repaired where necessary with clay. Several holes had been made in the sides of the pit by rodents, probably voles and rats. Before filling with grain, waste straw was burnt on the floors of the pits to purify and dry them after remaining open all the summer.

### *PIT B.*

A layer of straw was placed in the bottom of the pit to a depth of six inches to keep the grain from actual contact with the ground. The pit was then filled with a ton of barley at a moisture content of 15%. The grain reached to within six inches of the top edges of the pit. Since one cubic foot of capacity takes approximately 0.4 cwts. of grain, the unlined pit, if filled flush to the surface, would have accommodated some 22½ cwts. of grain as opposed to the same pit when lined taking only 19½ cwts. This 3 cwts. variable between a lined and an unlined pit would therefore have to be taken into consideration in any population computation envisaged. The copper CO<sub>2</sub> pipes were placed in position reaching 15 inches and 30 inches respectively from the grain surface into the pit. A further layer of straw was placed on top of the grain surface and the whole was covered with moist blue lias clay. The pit was then made flush with the ground surface with a thin layer of earth. This varied from the

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previous season when a mound of earth had been raised over each pit. As it was, the pit was virtually indistinguishable from the surrounding area and, therefore, probably nearer to Iron Age practice. A rain-water gauge was also set up on the site but after a few weeks it was stolen. However, from the findings of the previous year it would seem that the rainfall would be a minimal factor.

Carbon Dioxide<sup>1</sup> readings were taken at fortnightly intervals and the results of this and the previous year can be seen in the relevant table. It was noticed when taking readings late in November that rats had started burrowing down towards the large pit. Many of the holes started some three to four yards away from the pit itself, but were undoubtedly aiming in the right direction. These holes were immediately blocked and rat poison liberally spread. Fresh holes appeared intermittently thereafter throughout the winter, but only one actually succeeded in penetrating the pit. Although this caused a partial failure in so far as it introduced water into the grain and caused a certain amount of respiration to take place, it did not have the completely disastrous effect that was anticipated.

On January 9th, 1967, it was decided to open this pit and remove two to three cwts. of grain. The weather was cold and dull with a sprinkling of snow on the ground. Ground temperature was 0°C but the top of the pit was clearly defined as an open circle, the surface temperature here being 1°C. The temperature of the clay and the grain surface was 11°C and 18°C respectively. The straw on the grain surface was very rotted and the grain beneath was wet. About three inches below the surface, however, the grain was dry and in seemingly good condition. It was clear that the grain had formed its own protection walls against the sides of the pit as had been observed in Pit X the previous season. Three cwts. were extracted and the pit resealed using fresh straw on the grain surface. Results from the germination tests were disappointing, yielding a figure of only 50%. Mould samples<sup>2</sup> revealed some bacterial contamination with species of *Fusarium*, *Penicillium*, *Mucor* and *Alternia* present. At this stage there was no evidence of a rat succeeding in reaching the grain.

The pit was finally opened on March 23rd, 1967. The weather was bright and sunny. Ground surface temperature was 8°C, clay 8°C, grain surface 12°C and at the centre of the pit 32°C. The CO<sub>2</sub> pipes

<sup>1</sup> The pit gases were analysed by Mr. D. F. Ashdown, B.A.

<sup>2</sup> Mould samples were identified by Mr. C. L. J. Ryan, Plant Pathologist, Ministry of Agriculture, Fisheries and Food.

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had been badly damaged by vandals the preceding week and a final aspiration was consequently impossible. However, the extent of the damage inside the pit was only too apparent when the grain was removed. A rat had burrowed down into the pit some two feet six inches below the surface and by way of this hole water had seeped into the grain. Approximately one fifth of the grain was completely ruined being a wet yellow-brown rotting mass. Mould samples revealed that all the grains in this mass were contaminated with *Paecilomyces variota*. The remainder of the grain was dry but musty, mould samples indicating species of *Penicillium* and *Aspergillus*. Approximately twelve cwts. were recovered that would have been edible but infertile, making a sum total of fifteen cwts. recovered from twenty cwts. stored. The straw at the bottom of the pit was very compressed but quite dry. The actual floor of the pit was very slightly damp.

From the CO<sub>2</sub> tables it will be seen from the figures that the real damage occurred from the end of January to the time when the grain was recovered. A fact that is confirmed from the germination tests being positive in January and completely negative in March. Otherwise there is a marked similarity in the results before the end of January that would indicate that lining is basically unnecessary. In this particular instance rats caused a partial failure that Iron Age man would have most certainly averted.

### PIT X.

This small pit was treated in exactly the same way as the larger pit, being filled with three cwts. of grain and sealed with clay. It remained undisturbed throughout the winter and was opened on April, 18th, 1967. The ground temperature was 14°C, clay 14°C, grain surface 14°C and the centre of the pit 12°C. The grain was in perfect condition and virtually complete recovery was effected. Germination tests yielded a figure of 70% success and few mould species were discovered. There was a little sprouting at the grain surface, but only affecting the first inch. Otherwise the grain had built up its own protective wall as before.

The conclusions that can be drawn from these experiments which unfortunately cannot be continued, are quite clear cut. Grain can be successfully stored in unlined grain pits of the size excavated by Professor G. Bersu at Little Woodbury.<sup>3</sup> The pits can be opened

<sup>3</sup> Excavations at Little Woodbury, Wiltshire, *P.P.S.*, vi (1940), pp. 30-111.

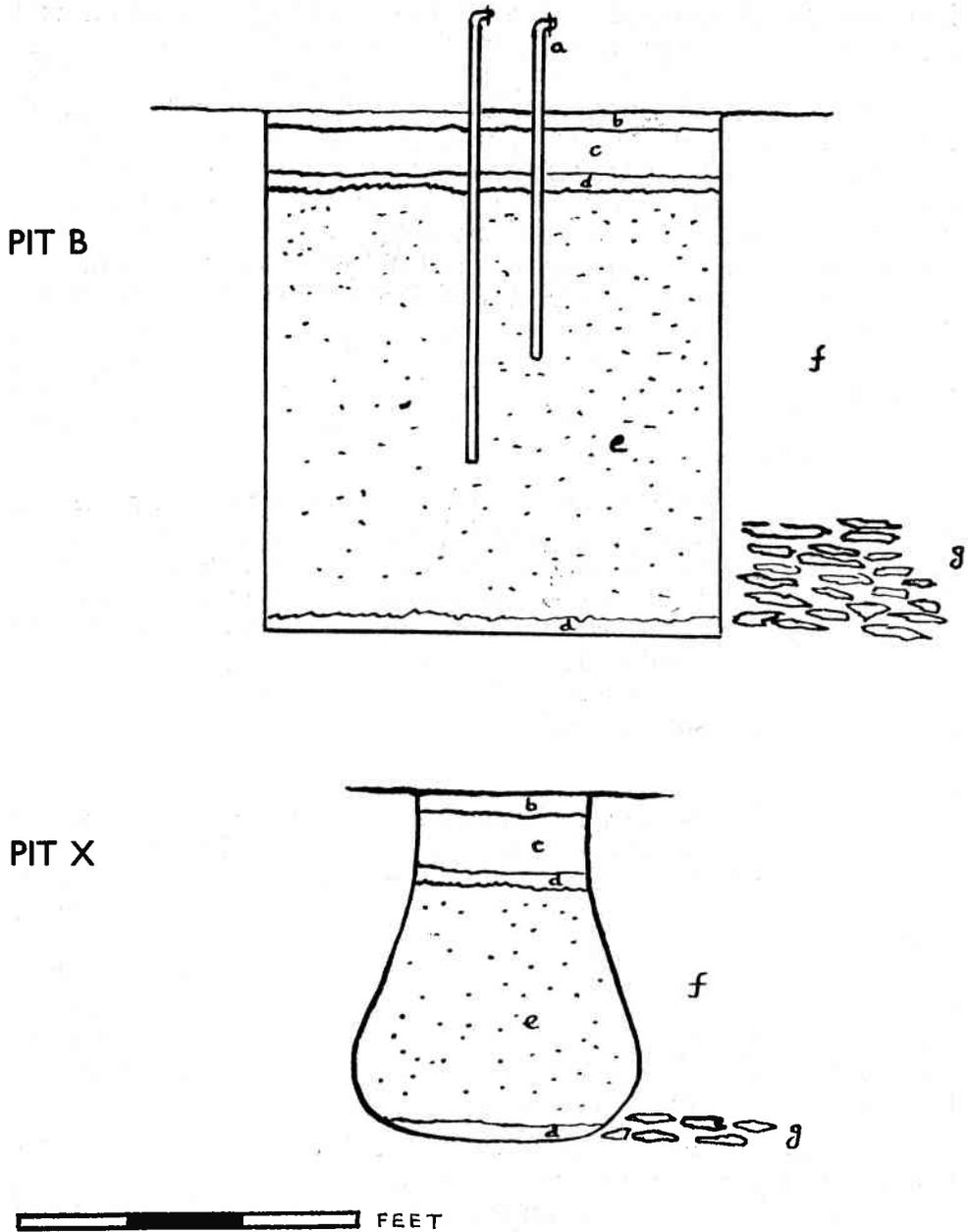


Fig. 1. Cross sections of Grain Pits

- |                 |               |              |          |
|-----------------|---------------|--------------|----------|
| a. copper pipes | b. topsoil    | c. clay      | d. straw |
| e. grain        | f. sandy loam | g. limestone |          |

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in the winter, a quantity of grain extracted and resealed without any adverse effects. In addition, given normal circumstances, the grain can be expected to give reasonably satisfactory germination results. The process by which the grain builds up its own protective wall of some 1½-2 inches thick would appear to be most important. On this occasion part of that wall was destroyed first by a rat and then by water and consequently a proportion of the grain was destroyed. However, provided this wall remains unbroken, the grain remains quite dry and in good condition.

A question that still remains unanswered is how long such a pit would stay in a fit condition for use before it turned sour and became used as a rubbish pit. The pits in this experiment stayed perfectly sweet for a period of two years during the summers of which they were left open. The experiment was due to be continued a third year but had to be curtailed. However, the pits were still in condition with no signs of mould.

TABLE OF COMPARATIVE CARBON DIOXIDE RESULTS  
PIT B

Date	1965-66 Lined			30 inch pipe		1966-67 Unlined		
	Ground Temp.	Vol. %	gms./litre.	Date	Ground Temp.	Vol. %	gms./litre.	
29. 9.65	3.2°C.	4.5	.09	28. 9.66	7.0°C.	2.8	.057	
13.10.65	4.9°C.	6.9	.1364	12.10.66	9.0°C.	4.0	.0786	
28.10.65	6.5°C.	5.05	.121	26.10.66	8.0°C.	4.4	.0865	
10.11.65	5.2°C.	5.05	.121	9.11.66	7.0°C.	2.2	.044	
24.11.65	-4.5°C.	2.2	.046	23.11.66	6.0°C.	1.0	.0185	
8.12.65	-7.8°C.	2.7	.054	7.12.66	2.0°C.	0.4	.007	
20.12.65	-1.0°C.	3.45	.069	14.12.66	4.0°C.	2.7	.055	
13. 1.66	-2.0°C.	1.5	.03	9. 1.67	0.0°C.	5.2	.103	
26. 1.66	1.3°C.	2.7	.054	30. 1.67	3.0°C.	8.6	.17	
23. 2.66	5.0°C.	2.6	.051	15. 2.67	2.0°C.	2.2	.046	
9. 3.66	9.0°C.	4.25	.085	1. 3.67	3.0°C.	10.2	0.2	
23. 3.66	9.0°C.	3.5	.07	15. 3.67	5.0°C.	10.2	0.2	

Readings from the fifteen inch pipe have not been tabulated since after January 13th, 1967 it was severely damaged. Prior to this date the figures by volume % were 4.2; 3.8; 2.3; 1.2; 4.7. These figures also reiterate the pattern of the thirty inch pipe.