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CREWE HOMICIDE INVESTIGATION REVIEW



**Forensic Findings of
Rory Shanahan, M.Sc.
Department of Scientific &
Industrial Research**

APPENDIX 10



Appendix 10

**'Corrosion of New, Fired, 0.22-Caliber, Long-Rifle Brass
Cartridge Cases Buried in Soil' (1976),**

by Rory SHANAHAN, M.Sc.

Department of Scientific and Industrial Research

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Appendix 10

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Corrosion of New, Fired, 0.22-Caliber, Long-Rifle Brass Cartridge Cases Buried in Soil

An important exhibit at a double murder trial was a 0.22-caliber, long-rifle, rim-fire cartridge case, which was found on microscopic examination to have been fired in the 0.22 pump-action rifle belonging to the accused. It was found at the scene, more than 18 weeks after the murders, buried approximately 50 mm below the surface of a garden.

After its discovery the cartridge case was handled by several policemen before it was forwarded to the laboratory, where it was handled by two scientists during examinations of the firing pin impression, extractor, and other marks. Because at this stage there was no suggestion that the cartridge case had not been exposed for 18 weeks, there was no specific observation of corrosion products and hence they were not recorded.

At the first trial it was not seriously contested whether or not the cartridge case had been buried for 18 weeks. In their preparation for an appeal and a retrial the defense exposed six fired cartridge cases on and in soil adjacent to the property and about 50 m from where the exhibit cartridge case was discovered. They recovered the cases 15 weeks later. After examining those that had been buried they made several claims:

1. The effects of corrosion on their cases did not resemble the effects of corrosion on the exhibit case.
2. The condition of the exhibit case was unusual compared with their cases.
3. They could offer no explanation as to why the exhibit case was relatively uncorroded compared with their cases.

From these experiments the defense alleged that the exhibit cartridge case could not have been exposed for 18 weeks. The history of the cartridge case prior to its discovery then became important.

The defense first closely examined the exhibit cartridge case two years after its discovery and after it had been extensively handled by several persons both in New Zealand and England. They asserted that the case had not been ejected onto the ground at the time of the homicides but had been placed there at a later date. This argument was pursued at the subsequent Court of Appeal hearing and at a second Supreme Court trial.

Questions posed to the prosecution by these defense arguments were these:

- (1) whether or not corrosion products on the outside of the exhibit case were consistent with its being buried for more than 18 weeks;
- (2) whether or not corrosion products on the exhibit cartridge case could be assessed by comparing them with corrosion products on cartridge cases buried 50 m away;

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(3) whether or not the corrosion products were permanent and would resist handling; and

(4) whether or not the characteristic microscopic marks would still be recognizable after this period in the ground.

Published work [1-8] on corrosion of metals buried in the soil was of limited assistance in answering these questions. Samples were usually larger (up to 380 mm long and 20 to 240 mm wide) and buried at greater depths (460 to 1220 mm) for longer periods (2 to 13 yrs). Upon removal from the soil the effects of corrosion were assessed by weight loss of the sample and by measuring the depth of pitting. No information was found on the effects of corrosion on a metal object as small as a 0.22 long-rifle brass cartridge case (15 by 5.5 mm) buried just below the soil surface for the relatively short time of 18 weeks. This paper is concerned with the study undertaken in an attempt to answer the above questions.

Experimental Procedure

Brass 0.22 long-rifle cartridges of ICI brand and of the same batch were fired in a Remington single-shot Model 510 rifle. This weapon imprinted finely detailed characteristic firing pin marks on the cases. The fired cases were numbered on their sides from 1 to 87.

Cases were buried just below (50 mm) the surface of the soil at 21 locations including the crime scene, usually in sets of four. At intervals up to 18 weeks from the commencement of the experiment, cases were recovered, washed with water to remove soil, and dried.

Corrosion Products

The amount of corrosion products present was estimated as a percentage of the case area, with the side and head of the case recorded separately. The color was assessed by comparison in daylight with color charts according to Kornerup and Wanscher [9].

Permanence of Corrosion Products

For preliminary tests on the stability of corrosion products, fired 9-mm parabellum cartridge cases, which had been exposed outdoors for unknown times, were picked up at a military firing range. From these cases three were selected of apparently identical dark coloration. One of these was randomly chosen, handled by several persons for a total period of 30 min, and then compared with the two untouched controls.

One of the pair of test-fired 0.22 cases buried at the crime scene was handled by two persons for 15 min and then compared with the untouched control and unexposed control.

Microscopic Markings

After the corrosion products assessment above, the firing pin marks on exposed cases were examined both under a stereo-binocular microscope and a Leitz comparison microscope.

Results

Corrosion Products

The amount of corrosion products and corrosion colors observed on the buried cases are presented in Table 1 and summarized in Table 2.

fired brass cartridge cases.

14 Weeks Buried				18 Weeks Buried			
Side		Head		Side		Head	
%	Color	%	Color	%	Color	%	Color
55	50% dark brownish gray, B 25% chocolate, D 25% tan, D	55	brownish gray (thin), D	95	40% ink blue, B 30% brown, B 30% brick red, D	95	70% ink blue, B 30% brick red, D
65	90% brown, B 10% Prussian blue, B	100	80% brown, D 20% Prussian blue, D	...	...	...	...
80	50% light brown, D 50% thunder blue (dark bluish gray), B	80	light brown, D	...	...	...	...
20	90% dark brownish gray, D 10% light brown, D	20	50% dark brownish gray, D 50% light brown, D	a	...	...	...
80	dark bluish gray, B	<5	...	a	...	...	...
20	dark grayish brown, B	<5	...	25	50% dark brown, B 50% hair brown, D	5	dark brown, D
...	...	...	...	20	mixture of brown, D and dark grayish brown, B	5	dark grayish brown, D
25	chocolate, D	45	chocolate, D	b	...	...	...
30	indigo blue, B	7	indigo blue, B	45	blackish blue, B	10	blackish blue, D
...	...	...	...	45	60% brown, B 40% blackish blue, B	10	blackish blue, D
90	ink blue, B	5	ink blue, B	90	thunder blue (dark bluish gray), B	90	thunder blue (dark bluish gray), D
...	...	...	...	90	thunder blue (dark bluish gray), B	100	thunder blue (dark bluish gray), D

—Continued.

14 Weeks Buried				18 Weeks Buried			
Side		Head		Side		Head	
%	Color	%	Color	%	Color	%	Color
55	dark brown, D	50	dark brown, D	90	reddish brown, D	95	reddish brown, D
...	...	...	...	100	85% reddish brown, D 15% olive, D	95	reddish brown, D
20	dark grayish brown, D	10	dark grayish brown, D	45	dark grayish brown, D	5	dark grayish brown, D
85	brownish gray, B	55	brownish gray (thin), B	30	dark grayish brown, D	10	dark grayish brown, D
...	...	...	...	100	dark grayish brown, 50% B 50% D	100	dark grayish brown, D
95	50% dark bluish gray, B 50% brown, D	40	50% dark bluish gray, B 50% brown, D	100	dark grayish brown, 50% B 50% D	100	dark grayish brown, D
35	brown, D	<5	...	75	90% reddish brown, D 10% blackish blue, B	45	reddish brown, D
...	...	...	...	15	hair brown, D	5	hair brown, D
85	sepia (brown), D	100	sepia (brown), (thin), D	25	brown, D	70	brown, D
...	...	...	...	100	teak (brown), D	100	teak (brown), D
30	70% thunder blue (dark bluish gray), B 30% brown, D	10	brown (thin), D	80	50% mustard brown, D 50% thunder blue (dark bluish gray), 50% B, 50% D	50	bluish gray (thin), D
45	85% brown, D 15% thunder blue (dark bluish gray), B	10	brown (thin), D	...	...	...	...

TABLE 1

[illegible]

—Continued.

14 Weeks Buried				18 Weeks Buried			
Side		Head		Side		Head	
%	Color	%	Color	%	Color	%	Color
50	75% brown, D 25% blackish blue, B	10	brownish blue (thin), D	...	...	...	...
5	bluish black, D	<5	...	7	mainly mustard brown, D with specks of thunder blue (dark bluish gray), D	0	...
...	...	...	...	15 ^c	raw sienna (brown), B	5	thunder blue (dark bluish gray), D
85	brown, B	0	...	85	brown, 50% B, 50% D	35	brown, 50% B, 50% D
...	...	...	...	75	brown, D	75	brown, D
...	...	...	...	90	brown, 80% B 20% D	45	brown, 80% B 20% D
30	50% blackish blue, B 50% dark grayish brown, B	65	dark grayish brown, D	...	...	...	...
30	80% dark grayish brown, D 20% blackish blue, B	7	dark grayish brown D	...	...	...	...
30	50% blackish blue, B 50% dark grayish brown, B	7	dark grayish brown, D	...	...	...	...
55	90% dark bluish gray, D 10% brick red, D	45	teak (brown), D	75	90% sepia (brown), B 10% deep blue, B	50	marine blue (blackish blue), B
...	...	...	...	70	45% sepia (brown), B 45% dark grayish brown, B 10% deep blue, B	60	90% sepia (brown), D 10% deep blue, B
grayish							

TABLE 1

Location	4 Weeks Buried				8 Weeks Buried			
	Side		Head		Side		Head	
	%	Color	%	Color	%	Color	%	Color
20 ^d
20
21 ^d
21

B = bright

D = dull

^a Two cartridge cases not recovered.^b One cartridge case not recovered, another recovered but not examined.^c One cartridge case not recovered.^d Two cartridge cases were buried.

TABLE 2—Summary of results shown in Table 1.

Time Buried, weeks	Corrosion			
	Side		Head	
	Range, %	Average, %	Range, %	Average, %
8	10- 80	46	0- 95	22
14	5- 95	50	0-100	30
18	7-100	58	0-100	44

Permanence of Corrosion Products

In preliminary tests, after six persons had handled the 9-mm case for a total time of 30 min, most corrosion products were removed, resulting in a marked change in the coloration from dull olive brown to bright straw yellow (Fig. 1).

The two cases which had been buried for 18 weeks at the crime scene, Location 20,

—Continued.

14 Weeks Buried				18 Weeks Buried			
Side		Head		Side		Head	
%	Color	%	Color	%	Color	%	Color
...	75	60% ink blue, B 40% brown, D	50	ink blue, B
...	75	60% ink blue, B 40% brown, D	45	ink blue, B
...	75	40% fawn, D 40% blackish blue, D 20% reddish brown, D	75	grayish brown, D
...	50	50% dark blue, B 4% fawn, D 5% burnt sienna (brown), D	25	80% burnt sienna (brown), D 20% dark blue, B

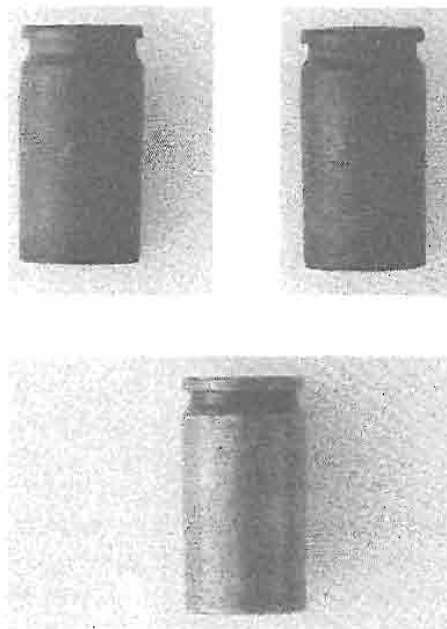


FIG. 1—*Permanence of corrosion products: (top) 9-mm parabellum cartridges, not handled, and (bottom) handled 9-mm parabellum cartridge.*

were found to be extensively covered with corrosion products (side, 75%; head, 50%; see Table 1 and Fig. 2). Their colors were a combination of ink-blue and brown.

After two persons had handled one case for a total time of 15 min, it was found that most of the corrosion products had been removed (Fig. 3, Rows 4 and 5).

Microscopic Markings

After dirt had been washed from the buried cases, each was examined with a stereobinocular microscope and the characteristic features of the firing pin impression were found to be still recognizable. In addition, the buried cases were readily matched with unexposed reference cases under the comparison microscope.

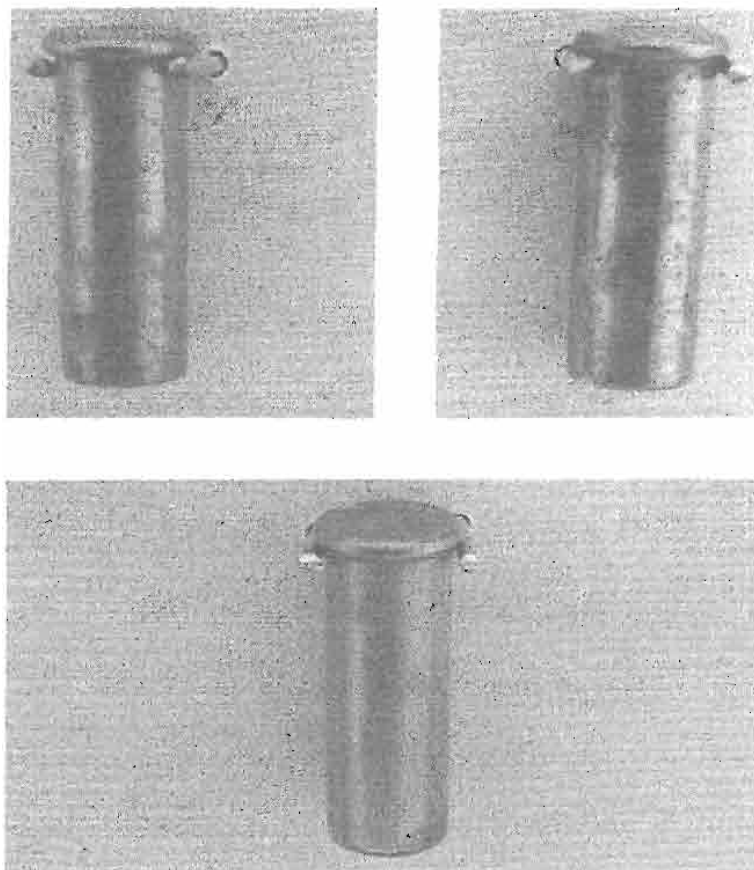


FIG. 2—Corrosion products on cases: (top) cases buried at Location 20 for 18 weeks and (bottom) fired reference case.

Discussion

Corrosion Products

The amount and color of corrosion products on the cartridge cases were extremely variable. The following observations were noted for the sides of the cases. The numbers in parentheses refer to the locations.

Corrosion products could be uniformly distributed or confined to one area. After 18 weeks the proportion corroded varied from 5 to 100%. Although the apparent effects of corrosion might be expected to increase with time, these occurred at only six locations

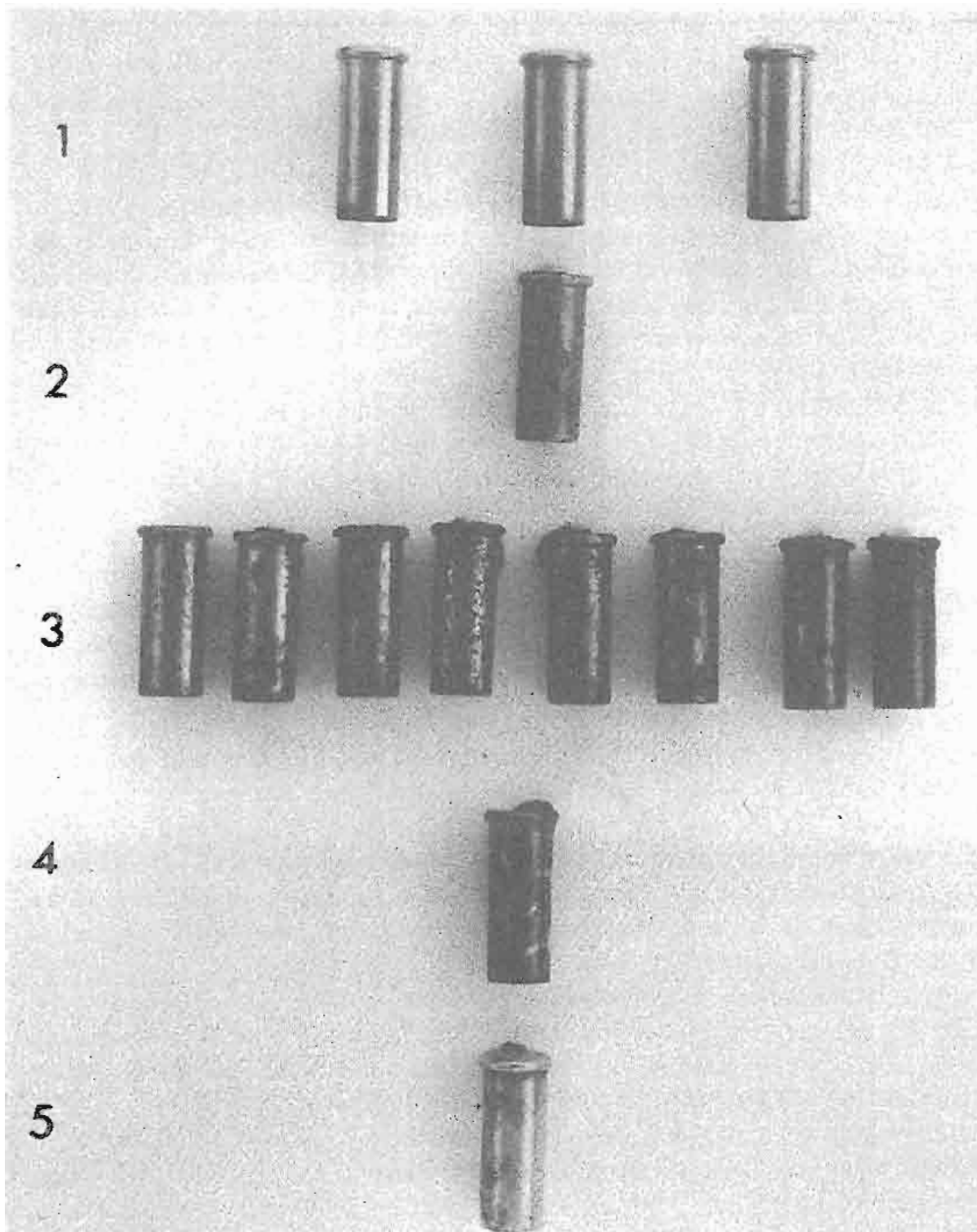


FIG. 3—*Variability and permanence of corrosion products: (Row 1) Fired reference cases. (Row 2) Exhibit case. (Row 3) Corrosion products on cases buried for 18 weeks: (left to right) Location 16, first case; Location 13, first case; Location 5, second case; Location 10, second case; Location 19, second case; Location 12; Location 8, first case; and Location 11, first case. (Row 4) Corrosion products on one of two cases buried at Location 20 for 18 weeks. (Row 5) Corrosion products on the other case buried at Location 20 after handling.*

(2, 4, 7, 11, 14, and 19). At Locations 5, 7, 17, and 18 they were relatively constant after different periods, while at Locations 3 and 6 they were less after the longer period. Corrosion products could decrease and then increase (9), the reverse could happen (12, 13), or they could remain constant for a time and then increase (10). Even cases buried side by side for the same period had different amounts of corrosion products (10, 14, 15, 16, and 21) or different corrosion colors (7, 14, and 15). Although corrosion colors did not change appreciably over the 18 weeks at most locations, they did at 7, 8, 15, 16, 18, and 19. Published work indicated that it was not possible to predict accurately from the

chemical and physical properties of a soil how buried mild steel will corrode [6,8]. There was nothing in the literature cited to suggest that this would not also be true for brass. As this experiment was not an attempt to relate observed corrosion characteristics with soil types, no attempt was made to classify or analyze soils.

Some of the varying corrosion characteristics are illustrated in Fig. 3, Row 3. Similar observations were noted for corrosion products on the heads of cases.

The police alleged that the evidence case was left at the scene of the homicides on approximately 17 June 1970 and found on 28 Oct. 1970. To minimize climatic variables the same season and duration were chosen for this study. Cases were buried from 21 to 25 June 1972 and recovered at periods up to 30 Oct. 1972. Although weather records were not kept at the crime scene, which was a farmhouse in the country, general observations indicated that the weather was normal during the experimental period.

Although when first ejected a cartridge case would probably lie on the ground surface, the cases in this study were buried to minimize the risk of their being removed by curious animals or persons.

Permanence of Corrosion Products

It is commonly observed that dull (corroded) brass objects brighten as handling removes some corrosion products from the high spots and flats (for example, the handle of a brass tap is usually brighter than the remainder of the tap). Similarly, the handled 9-mm parablellum cartridge case studied brightened, and the corrosion products on one of the buried 0.22 cases taken from the crime scene were found to be superficial and readily removed. The handling was an attempt to simulate the treatment which the cases would receive during examination under the stereo-binocular and comparison microscopes. Throughout this study, therefore, care was taken not to touch the exterior of the cases with fingers. When assessing corrosion products the cases were held for examination by a rod inserted within the cases.

A newly manufactured cartridge case appears uncorroded. After firing and burial for 18 weeks the corrosion products present on such a case are largely removed by normal handling. Microscope examination, however, will show some corrosion products still remaining in scratches, hollows, and other relatively inaccessible parts.

Cartridges kept several years, even in their packets, can have significantly corroded cases. Experiments show these corrosion products are more difficult to remove by handling than corrosion products on a new cartridge case after burial. On each kind of case, however, any remaining corrosion products are brightened by handling.

The scene was unoccupied and under police security for five months after the murders. The garden was undisturbed until a search with a sieve found the exhibit case. When it was found, no notes were made of its appearance. Figure 3, Row 2 shows the appreciable amount of corrosion products still remaining at the time of this study (side, 30%; head, 10%; both mustard-brown colored), even though the case had been extensively handled by several persons both in New Zealand and England. From other evidence, it is believed that before firing the cartridge was at least 7 years old, hence the more tenacious kind of corrosion products could have been on the case when it was ejected onto the soil. This could explain the corrosion products remaining when studied; handling had removed the superficial corrosion products resulting from its burial, leaving the more tenacious kind which had been present before firing. There was nothing inconsistent in the appearance of corrosion products remaining on the cartridge case to suggest it had not been exposed for 18 weeks as alleged.

From this study it was concluded that it was not possible to

- (1) predict the amount or color of corrosion products that would be present on a

new, fired, 0.22, brass cartridge case buried just below the soil surface for 18 weeks;

(2) assess corrosion products on the exhibit cartridge case by comparing with corrosion products on cartridge cases buried at a different location; or

(3) relate corrosion products on the exhibit cartridge case to a time two years earlier, when in the interim period the cartridge case had been extensively handled by several persons.

Summary

Although new, fired, 0.22, brass cartridge cases buried in soil for more than 18 weeks may be expected to be corroded, the amount and color is extremely variable, even with cases buried side by side. Therefore corrosion products on a cartridge case buried at one location cannot be assessed by comparing with corrosion products on a case buried at a different location.

As corrosion products on the cartridge cases are of a superficial nature they are likely to be removed rapidly by handling. If this occurs, corrosion characteristics cannot be related to an earlier time.

On corroded cases the characteristic fine detail in the firing pin impressions remains recognizable.

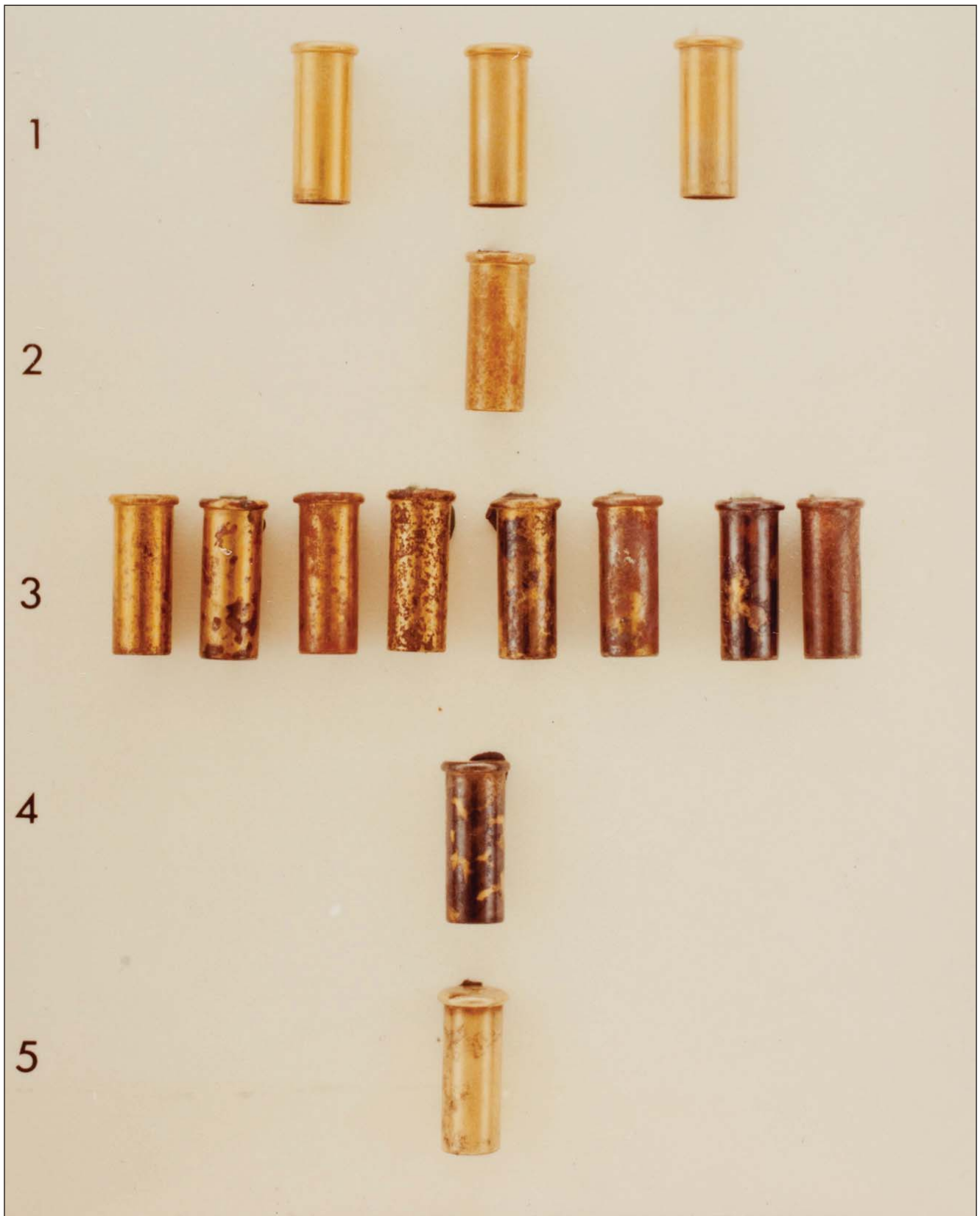
Acknowledgments

The author wishes to thank Sergeant D. O. Roberts, New Zealand Police, Auckland for supplying the photographs, and Assistant Commissioner J. W. Overton for permission to publish them.

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Coloured photograph of FIG 3. Pg 625 of article 'Corrosion of New, Fired, 0.22-Caliber, Long-Rifle Brass Cartridge Cases Buried in Soil' study conducted by Rory Shanahan.



Appendix 10

**Statement of Rory SHANAHAN, M.Sc.
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My full name is RORY SHANAHAN. I have a Master of Science degree in Chemistry from Auckland University and am a Fellow of the New Zealand Institute of Chemistry. I have been working in the field of forensic science for 16 years and have been head of the criminalistics section at Chemistry Division, D.S.I.R., Auckland since 1974.

Together with Dr Donald Nelson, who is the Government Analyst in Auckland, I have been involved in all forensic investigations arising from the Crewe homicides in June 1970.

1. Initial Inspection: At the request of the Police, Dr Nelson and I visited the Crewe farm for the first time on 23rd June 1970. The living room at the house was extensively blood-stained. We took samples of these stains from three locations and also took some biological tissue from a chair. We forwarded the blood samples for grouping to Dr Staveley from the Blood Transfusion Centre at Auckland Hospital and the tissue to the pathologist, Dr Cairns for his examination. We noted that something appeared to have been burned in the fireplace and that ashes remained. Outside the front door near the front steps we found a small nodule of rust. We found similar rust nodules on the underside of a barrow which was standing near the backdoor of the house. There were several fresh hollows

on the barrow where similar rust nodules appeared to have fallen off. I took the rust nodule found lying on the ground and one from the wheelbarrow and sent these to Mr Todd at the D.S.I.R.'s main laboratory in Petone for spectrographic analysis.

2. Mr Demler's car: On 26th June 1970 Dr Nelson and I examined Mr Demler's car registration number EF9225. A Policeman had described the car to us as containing many bloodstains. Dr Nelson and I examined the car thoroughly both inside and outside and also inside the boot. The inside of the car indeed had a number of reddy-brown smears which superficially at least looked like dried blood. Using a well-known chemical test for blood we were able to ascertain that all but two of the marks in the car were not blood. Two blood smears were found in the car. One smear was on the front seat and the other smear was adjacent to the first smear and on the back of the seat. Both smears were very light and the pattern in the plastic covering the seat was clearly visible through them. This feature is well illustrated in one of the Police photographs. We removed completely the stain from the front seat and sent this to Dr Staveley for blood grouping.

We were informed that the result of Dr Staveley's

tests on the blood from Mr Demler's car was that the blood was the same blood group as Jeanette Crewe's blood. Apparently Mr Demler had informed the Police that Jeanette had cut her finger and it had bled on to the seat of the car. At a later date we conducted an experiment in the laboratory in which measured quantities of blood were smeared on the plastic covering a chair seat. From this experiment we formed the opinion that each smear in the car could have been produced by not more than 0.01 ml. of blood, that is to say a small drop less than 3 mm. in diameter, which was entirely consistent with Mr Demler's explanation of Jeanette's cut finger.

3. Ashes from the Fireplace: On 21st July 1970 I received from Detective Abbott ashes from the Crewe fireplace and also some ashes which were stated to have been left after the Police test burned a carpet and a cushion taken from the Crewe lounge. I compared the two lots of ashes and found that some of the ashes from the fireplace were consistent in physical appearance with the test burned carpet and some other ashes were consistent in physical appearance with piping from the test burned cushion. I had been informed by the Police that missing from the lounge was a cushion and also a small mat which had been in front of the fireplace. It seemed likely from my examination that the missing cushion

and missing mat had been burned in the Crewe fireplace.

4. Wire Samples: I was informed that on 16th August 1970, the Police found the body of Jeanette Crewe with a length of copper wire tied around it. I understand that samples of copper wire were then taken from off the Crewe property and from off the Demler farm and I forwarded these three samples to Harry Todd at the D.S.I.R., Petone for spectrographic analysis. Similarly I understand that the body of Harvey Crewe was found on 16th September and this had both copper wire and galvanised wire wrapped around it. I understand the Police then made a collection of numerous samples of both copper wire and galvanised wire from farms in the district and these were given to me with samples of the wires from Harvey's body again for spectrographic analysis by Harry Todd.

4. Stomach Contents: On 17th August 1970 I received from the Police the stomach contents from Jeanette Crewe and on 17th September I received from Detective Cook the stomach contents from Harvey Crewe. On 1st October 1970 I received from Detective Abbott the remains of two fish meals which I observed on the Crewe's dining table on 23rd June 1970 during my first visit to the property. The only visibly recognisable food stuffs in both stomach contents

were whole green peas which were bright and fresh looking after having been washed with water.

I then analysed the fats in both stomach contents to see if they were the same as the fats present in the remains of the fish meals left on the Crewe's dining table and furthermore whether the fats in the stomach were distinguishable from some other test samples of household fats.

This involved an analytical procedure, and the results of my experiments were that the fats in each of the stomach contents were the same as the fats found in one of the remaining fish meals on the Crewe's dining table and were distinguishable from the other samples of household fats.

I concluded and said in evidence that the contents of the stomachs indicated that the two deceased persons consumed the fish meals as their last meal.

5. Axle: On 21st October 1970 I examined an axle which I understood to have been found in the Waikato River beneath Harvey Crewe's body and two stub axles, or wheel assemblies which I understood were found on a tip on Thomas' farm. The purpose of my examination was to examine the two points of separation to determine whether or not the two wheel assemblies and axle had all originally been together as one unit. My preliminary examination with the unaided eye indicated that this appeared to be so. Both

the wheel assemblies had been separated from the main axle at either end at a point where the wheel assemblies were joined to the axle by means of stub axles. The separation of one wheel assembly appeared to have been effected by using a combination of an oxy-acetylene flame and hammer blows, or a similar action, while the separation of the other wheel assembly appeared to have been effected solely by hammer blows. At each point of separation there were jagged fracture lines.

With a hand held lens I examined closely these lines of fracture and observed that each wheel assembly fitted to each end of the axle as do pieces in a jigsaw puzzle. These physical matches left no doubt in my mind that the two wheel assemblies and axle had originally been together as one unit. Photographs were taken under my supervision and direction showing the matching of the axle and wheel assemblies and ^{put in} were in evidence. I have never been cross-examined on this evidence.

6. Examination of Charles' Cartridge Case

(Exhibit 350): On 28th October 1970 Dr Nelson who had been concerned mainly with the ballistic aspects of the Crewe Enquiry up until that stage was overseas for a visit of about a fortnight. On that date I received from

Detective Sergeant Charles a fired 0.22 long rifle calibre brass cartridge case which I was informed had been found in the garden outside the Crewe house. Before his departure overseas I was aware that Dr Nelson had given a verbal report to the Police that from among the 64 rifles which he had test fired that only two rifles could have fired the bullets found in Jeanette Crewe and these were rifle C10A and rifle C3B. Accordingly when I received the cartridge case I was asked by the Police whether it could have been fired in either of the two rifles ie. C10A and C3B.

I immediately placed the cartridge case in a container labelled 'X6915,350' which was the laboratory number that I assigned to it and from that time on except when I was actually examining the cartridge case I ensured that it was kept in the labelled container at all times. I also marked the inside of the cartridge case with a red felt pen to identify it for future reference. This cartridge case became known both as Exhibit 350 and as the Charles cartridge case.

For my examination of the cartridge case I got out the retained cartridge cases marked C10A and C3B which were held from Dr Nelson's test firing of the 64 rifles and I compared Exhibit 350 and the test cases for points of similarity. Dr

Nelson has elaborated in his evidence the various points of similarity which are looked for and I simply say and gave evidence at both the First Supreme Court trial and the Second Supreme Court trial that the firing pin impression, the extractor mark, and breech face marks on Exhibit 350 all showed without any doubt that Exhibit 350 was a cartridge case which had been fired in rifle C10A. A corollary to my evidence was that there was also no doubt that Exhibit 350 had not been fired in rifle C3B, and indeed I found that the firing pin impression on Exhibit 350 was readily distinguishable from the firing pin impressions on cartridge cases fired in rifle C3B. From the Police schedule of rifles I determined that C10A was Thomas' rifle and that C3B was Eyre's rifle.

I reported my findings to Detective Inspector Hutton on the afternoon of 28th October, ie. the afternoon on which I received the cartridge case. At the same time I asked him to arrange for rifle C10A to be given to me by the Police so that I could re-test fire it this time using cartridges with brass cases. My reason for this was that all Dr Nelson's test firing of the 64 rifles had been carried out using cartridges with gilding metal cases and it is standard forensic practice to compare like with like whenever possible.

The rifle was delivered to me the next day that is the 29th October 1970. On that day I took rifle C10A to the Boystown rifle range. From recollection I was accompanied by Detective Inspector Hutton. I test fired the rifle using a total of 14 cartridges with brass cartridge cases and I was careful to retain all 14 fired cartridge cases and to place these in a labelled container. I then returned to my laboratory and looked at a selection from these 14 cases. This examination confirmed my opinion from the day before that C10A had indeed fired the cartridge case Exhibit 350.

Following this re-test firing I carried out my normal procedure and marked the laboratory number 'X6915,350' with a diamond tipped pen on to the side of Exhibit 350 and then put it back into its labelled container. In a similar manner, I also labelled the 14 test fired brass cartridge cases C10A-1 to C10A-14 inclusive on their sides with a diamond tipped pen and replaced them back in their labelled container. All 14 of these test fired cartridge cases were produced by me as an exhibit at the depositions and at the First and Second Trials.

On 9th November 1970 after Dr Nelson had returned to New Zealand from his overseas trip and I asked him to examine Exhibit 350 and to give a

second opinion. His examination agreed with my findings and conclusions. At a much later date as explained in Dr Nelson's evidence the 14 cases from my test firing and Exhibit 350 were all sent to England where the Home Office Forensic Science Laboratory at Nottingham also confirmed our findings.

7. Corrosion: Before commencing this topic it may help the Commission if I define at the outset what is meant by corrosion.

I stress at the outset that I am not an expert in the study of corrosion and the comments I make are from general background scientific knowledge gained over the years. Corrosion is a process whereby a metal forms compounds or corrosion products by combining with substances from its immediate environment.

The cartridge cases with which we have been concerned in the Crewe Enquiry are all manufactured from brass, which the Commission will probably be aware is an alloy of copper and zinc. I understand that brass cartridge cases are 70% copper and 30% zinc. The corrosion of brass is a complicated process which is known to be very unpredictable and affected by a very large number of factors. A newly manufactured brass cartridge case usually has a shiney

surface. When it is buried in soil, brown and black oxides of copper are among the corrosion products formed. The corrosion initially takes the form of a surface discolouration and as the period of time buried increases can proceed further so that the surface is actually eaten away and pitted. I make these introductory comments with a view to assisting the Commission to understand the meaning of the term 'corrosion'.

The issue of corrosion in relation to cartridge case Exhibit 350 arose from suggestions put forward or implied on behalf of Thomas that this cartridge case should have been more corroded if it had been in the ground for 4½ months (as the Crown case required), between the shooting of the Crewes and its being found by the Police.

When I first received Exhibit 350 it was given to me as I have already explained to see whether it had been fired from rifle C10A or rifle C3B and I was not asked to examine the cartridge case from the point of view of assessing the degree of its corrosion; nor did it occur to me to do so. When I received Exhibit 350 I made no note of its appearance, or the degree of any corrosion products present, but when the question of corrosion was first arising, and

casting my mind back to its condition at the time when I first saw it, my memory of Exhibit 350 was that it was not bright and shiny like a newly manufactured cartridge case, but rather had a dull appearance. It was not extensively covered with corrosion products in a way that some of my later test cartridge cases were after being buried in soils for 4½ months.

The issue of corrosion first arose when I was asked about the degree of corrosion on Exhibit 350 at the deposition hearing and this was when I had to cast my mind back to the appearance of the cartridge case when I had first received it about 1½ months earlier. It was also the subject of questioning at the First Supreme Court trial and gained importance at the First Referral hearing and at the Second Supreme Court trial.

It came to my attention via a Sunday newspaper after the First Supreme Court trial that the defence were carrying out corrosion tests and were burying cartridges apparently with a view to examining them at a later date for the degree of corrosion present. Accordingly on 21st June 1972 at the request of Mr Morris, Crown Prosecutor, I commenced a similar experiment to examine corrosion characteristics on fired 0.22 long rifle cartridge cases buried beneath the soil at various locations. The experiment

ended on 13th November 1972. Essentially the experiment involved burying 84 cartridge cases at 21 locations around the Auckland Province, one of which locations was the Crewe garden where Exhibit 350 had been found. ~~✗~~ The cartridge cases were buried usually in groups of four for varying periods from 1 to 4½ months. The principle was to uplift one of the group of four from each location at intervals after one month and assess its corrosion products. The results from my experiment have been photographed and are attached hereto.

I should add that eight of the buried cartridge cases at six locations were lost and were never recovered even although the persons taking part in this experiment knew to within a few inches where they had buried the cartridge cases under test. I noted also that a total of 16 of the cases had dry soil inside them rather than damp soil when they were dug up after 4½ months.

~~✗~~ ~~✗~~

In essence the experiment showed that corrosion products produced on the cartridge cases were extremely variable both in amount and colour. Looking at photograph A line 3 the Commission will see a great range in the amount and colour of corrosion products and yet all eight cartridge cases along line 3 were buried for the same period of 4½ months. Another finding from my

experiment was that the corrosion products on the cartridge cases were readily removed by handling. The cartridge case shown beside the number 4 in the photograph is seen to have darkly coloured corrosion products. This cartridge case was taken from the Crewe garden. A cartridge case also taken from the Crewe garden with similar corrosion characteristics was handled by several persons for 20 minutes in the normal sort of way which a fired cartridge case would be handled to examine the firing pin impression and other marks and was then photographed beside the number 5 in the photograph A. Both cartridge case 4 and cartridge case 5 were in the Crewe garden for a similar period of time namely $4\frac{1}{2}$ months and yet it will be seen that the corrosion products were almost completely removed by handling. I draw to the Commission's attention that cartridge case number 2 on photograph A is Exhibit 350 showing its degree of corrosion at the time that these photographs were taken, namely 22nd November 1972. I summarise my findings from the study by saying:

1. The corrosion products on brass cartridge cases buried in soil for short periods of up to $4\frac{1}{2}$ months are extremely variable and unpredictable even on cases buried side by side. This variability includes all parts of the cartridge case, even the radius area, where the side of the cartridge case

curves outwards to form the rim.

Corrosion products on a cartridge case at one location cannot be compared therefore, with corrosion products on another cartridge case at a second location, even if the two locations are as little as a few centimetres apart.

2. By examining the corrosion products on cartridge cases buried at many locations I showed that this variability in the degree of corrosion was the general rule.
3. My experiment showed me that most of the corrosion products resulting from a burial of brass cartridge cases in the soil for a period of 4½ months were removed rapidly by handling.

I said in evidence at the Second Trial (page 244 lines 25-30) that from my experiment it was my opinion that Exhibit 350 could have been buried in the soil on the Crewe farm for 4½ months.

I published a detailed report of my experiment in 1977 in the Journal of Forensic Sciences which is an American publication and a copy of this paper is attached for the Commission's information. Scientific papers are assessed by referees prior to publication and the comments of one of the referees, Mr L W Bradford,

were particularly complimentary. I attach his comments and also his curriculum vitae for the Commission's information.

8. Chennell Estate Rifle: On 2nd April 1973 Dr Nelson and I received a rifle from Detective Cook. The rifle was old looking and was contained in an old gun case, which was coated with dust and cobwebs that did not appear to have been disturbed for many years. The firearm was an obsolete double barrelled rifle. The right hammer could be cocked and fired, but the left hammer could not be cocked. The rifle was chambered for a cartridge longer than the 0.22 long rifle cartridge and had a bore diameter of 0.35". It would not have been possible to fire a 0.22 long rifle cartridge from this weapon.

9. Sundry: In this section of my evidence I merely wish to confirm certain matters dealt with in the evidence of Dr Nelson. I can confirm that I was present and assisted on all occasions for the test firing of the 64 rifles at the Boystown Rifle Range in Nelson Street, Auckland and that the test firings were conducted carefully under the supervision of Dr Nelson.

Secondly, I can confirm that I attended the Crewe house on the evening of 13th October 1970 when Dr Nelson and a policeman fired shots from

outside the house through the kitchen louvre ,
windows into telephone books mounted on a chair
in the lounge.

*7

Thirdly, I can confirm that I was present at the
Supreme Court in Auckland at the end of the
Second Trial when Dr Nelson compared Exhibit 343
and Exhibit 350 with regard to the height of
the "C"s in their "I.C.I." headstamps and I
was also present in the D.S.I.R. laboratory
at Auckland later the same day when Dr Nelson
measured the height of the "C"s with a microscope.
Both at the Supreme Court and at the laboratory
I re-measured the height of the letters "C" after
Dr Nelson had made his measurements and in both
cases my measurements coincided exactly with
his and my conclusion was the same as his that
there was no difference between the size of the
two "C"s. I can also confirm that the head-
stamps in Exhibit 343 and Exhibit 350 were both
trapezium shaped and that this shape was more
distinct in Exhibit 343 than in Exhibit 350.
I noted also that Exhibit 350 had my laboratory
number 'X6915,350' scratched on its side.
I did not inspect Exhibit 343.

Fourthly, I can confirm that I was present at the
Boystown rifle range with Dr Nelson on 27th
March 1973 during the Second Trial when we re-test
fired rifle C10A and measured how far freshly

fired cartridge cases were ejected. I can confirm Dr Nelson's evidence that cartridges were ejected for distances up to 13 feet, and a copy of my notes taken at the time is produced. Finally, I can confirm that subsequent to the Second Supreme Court trial I have assisted Dr Nelson with most of the measurements of the samples of the headstamps of various cartridge cases etc. brought back from Australia by Dr Nelson or otherwise obtained by him and that I have assisted him in arriving at his conclusions. In many cases the numerous measurements which were made of the headstamp impression were carried out more or less jointly in order to try and ensure that scrupulous accuracy was maintained. I can confirm that of all the "I.C.I." headstamps we have measured, not one has a centres height of 1.2 mm. which was Dr Sprott's measurement for Exhibit 343 and was given in evidence by him at the Second Supreme Court Trial. *XJ*

10. Colonial Ammunition Company Production Records:

I have recently examined the production records of the Colonial Ammunition Company Limited in Auckland with a view to determining the annual level of production of 0.22 long rifle rim fire cartridges with brass cartridge cases. This task was a relatively simple one involving the adding up of weekly production levels from the well-kept production records of Colonial

Ammunition Company, copies of some of production records appear in Volume 8 pages 67A-E.

I summarise the results of my examination as follows:

<u>Year</u>	<u>Total production of 0.22 long rifle cartridges with brass cases</u>	
1956	12,910,000	
1957	9,480,000	
1958	12,437,000	
1959	9,020,000	
1960	8,690,000	
1961	9,787,500	
1962	9,169,900	
1963 to 8.11.63	7,464,500	) 9,704,500
rest of year	2,240,000	
1964	12,450,800	
1965	13,428,000	
1966	10,685,000	
1967-1970 (inclusive)	23,098,000	
<u>TOTAL:</u>	140,859,700	
<u>YEARLY AVERAGE:</u>	9,390,647	

11. Dr Sprott's 0.22 long rifle ammunition collection: On 14th and 18th June 1980 I inspected and counted 0.22 long rifle cartridges at the Laboratory of Dr T J Sprott. The numbers of rounds of ammunition counted by me were as follows:

Total cartridges	17,680
Total long rifle brass cartridges	15,479

Consisting of:

(a) Broad arrow	3,774
Serif	905
Broad arrow/serif	1,530

<u>Total other than sans serif</u>	6,209
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(b) Sans serif 3 cannellure	2,740
Sans serif 2 cannellure	1,139
Assumed sans serif 2 cannellure	5,391

<u>Total sans serif</u>	9,270
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Of the cartridges still in C.A.C. packets, only those in the packets bearing order or batch numbers 1335 to 4100 inclusive were sorted, it being assumed that orders 1 to 1335 were broad arrow/serif and 4101 to 5880 were sans serif 2 cannellure.

Distance across jet from Thomas' rifle
(at Boyston)

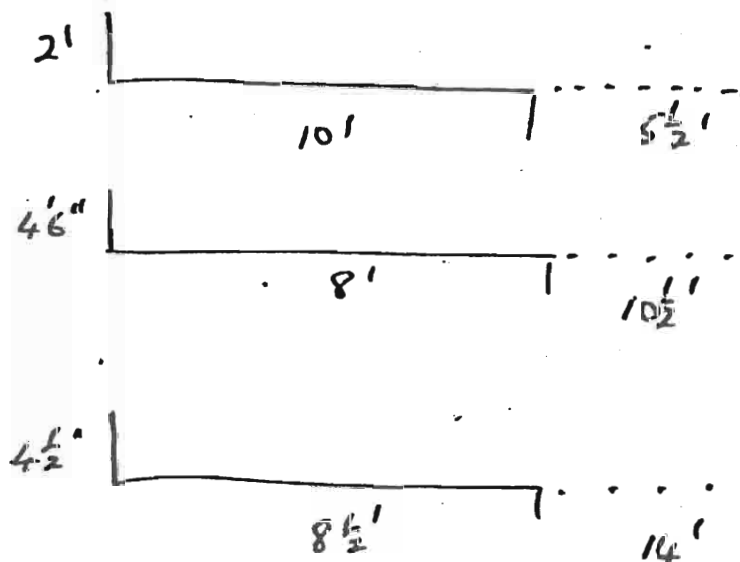
27 March 1973

DFN, RS and Det. Abbott. (0730 - 0830)

DFN facing

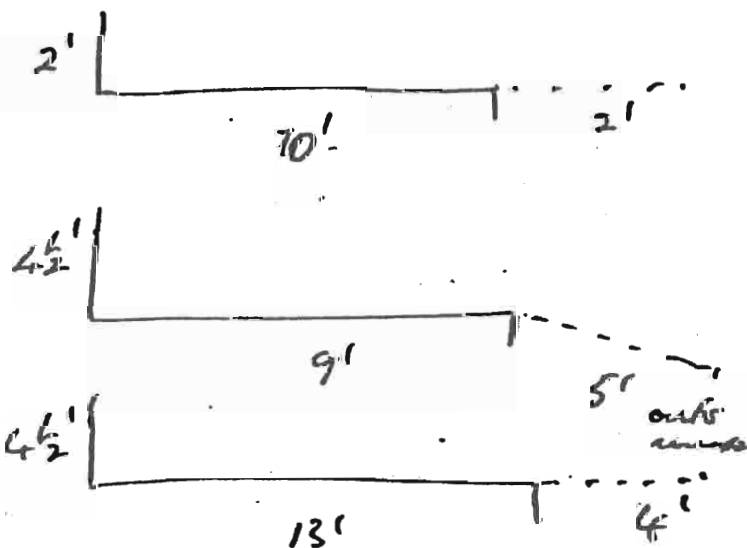
Rifle vertical

- 1) Auto platform (masonry)
- 2) " floor (concrete)
- 3) " floor



() Rifle 45°

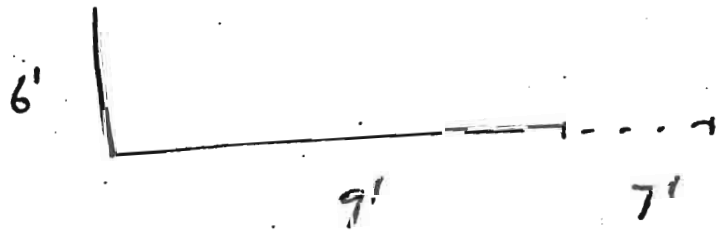
- 1) Auto platform
- 2) " "
- 3) Auto concrete



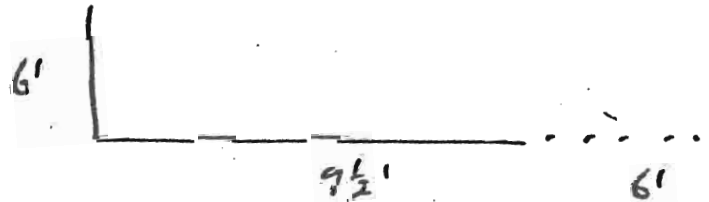
NS joining

Right vertical

1) Out to ~~source~~ ^{four}

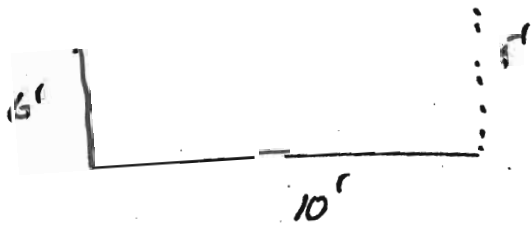


2) Out to source



Right 45°

1) Out to source

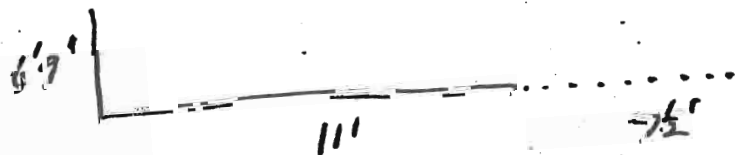


2) "

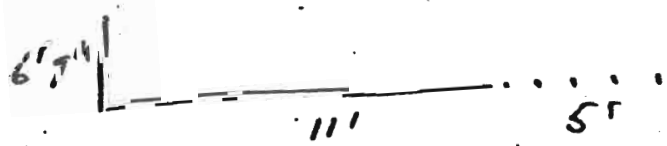


Right 10-20°

1) "



2) "



Meningeal pouch (i.e. pouch loaded into rifle)

^{ejection}
2" by DFN — 7-9' onto ~~the~~ ^{concrete}

2" by RS — 7' " "

Note Magazine holds 10 rounds up to
loading port.

M. P. All head stamps 1C1
23/2/74

