

ON HER MAJESTY'S SERVICE

WASC 498
WANBD 15



~~WASC 498~~

Court of Inquiry
Report

18-1-40 Mixing
House Explosion

[For Images See
WASC 499]

~~WASC 498~~

WASC 498

~~WASC 498~~

Explosion 18/11/40

WASC 498

~~WASC 498~~

~~WASC 498~~

Court of Enquiry

Report

COURT OF ENQUIRY

Postage must be Prepaid on all Letters, etc., sent to this Office. •

R.O.F. FORM 1.

Telegrams: Factories, Woolwich.

Telephone: Woolwich, 2080. Ext.....

From CHIEF SUPERINTENDENT OF
ORDNANCE FACTORIES,
ROYAL ARSENAL, S.E. 18.

To Royal Gunpowder Factory,
Waltham Abbey, Essex.

(For the attention of Lt. E.L. Blee
and C.J. Haslar Esq.).

PLEASE QUOTE
IN YOUR REPLY.....

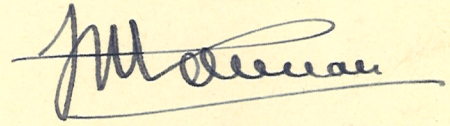
262183(7)

SECRET.

18.1.40
→

Explosion at R.G.P. Factory, Waltham Abbey,
18/2/40.

I forward herewith one copy of the final Proceedings
of the Court of Inquiry for your information and retention.



Lt. Col.
M.A. to C.S.O.F.
President.

1/3/40.
IMC.

S E C R E T.

Proceedings of a Court of Inquiry assembled at
Waltham Abbey on the 18th January, 1940, et seq.,
by Order of the Director of Ordnance Factories,
for the purpose of inquiring into the circumstances
attending an Explosion at the Royal Gunpowder
Factory on 18th January, 1940.

PRESIDENT.

Lt. Col. J.C.E. Pellereau, O.B.E. - M.A. to C.S.O.F.

MEMBERS.

H.A. Phillips, Esq., F.I.C. - A.D.O.F.(X)
Ministry of Supply.

Col. J.S. Mellor, O.B.E., M.C. - Chief Constable,
M.I.5.P.

Capt. A.S.T. Godfrey - War Office.

R.P. Evans, Esq., B.Sc. - Superintendent,
R.O.F. Irvine.

Dr. T. Barratt, D.Sc. - Research Department.

E. Garratt, Esq., B.Sc. - Research Department.

IN ATTENDANCE.

Dr. H.E. Watts, M.B.E., Ph.D., - H.M. Inspector of
B.Sc., F.I.C. Explosives.

SECRETARIES.

Lieut. E.L. Blee - York & Lancaster Regt.

C.J. Haslar, Esq. - R.G.P.F.

Court of Inquiry on Explosions at the
Royal Gunpowder Factory, Waltham Abbey,
which occurred at about 10.40 a.m.
18/1/40.

The Court assembled at 5.0 p.m. on 18th January, 1940, and took preliminary evidence on the nature of the work carried out in the part of the factory where the explosions had occurred, and on the extent and the nature of the damage.

1. Survey of Damage.

- (a) The explosions occurred in the Nitro Glycerine Section of the Factory, two guncotton drying stoves (Nos. 14 and 18), a truck loaded with guncotton and a mixing house (No.5) having exploded while a third drying stove (No.19) had been burned out. A statement giving the particulars of these buildings, their contents and the condition of the guncotton in the Stoves, is given in Appendix I.

Apart from the actual explosives the contents of the various buildings concerned amount to very little. The Stoves contain only wooden racks, with wires for the Guncotton Primers, and a wooden platform. Guncotton on the top racks would be uncovered. The Mixing House contains practically nothing that is not incorporated as part of the building. The paste mixing tables are made of lead and welded to the lead floor and consist of a shallow pan with a phosphor-bronze screen at one end through which the Paste is rubbed into a calico bag secured under the hopper beneath the table.

- (b) A considerable amount of damage was also caused to surrounding buildings, such damage ranging from complete destruction in the case of two or three buildings close at hand, to slight damage, such as doors blown off the hinges, broken windows, etc., to more distant buildings.

A Dry Guncotton Weighing House was completely wrecked by the blast and also the Wash Water Settling House, though in the latter case the plant underneath (consisting chiefly of a large wooden vat) was undamaged.

- (c) A map of the district showing the degree of damage sustained is given in Appendix II.

The approximate total damage is tabulated in Appendix III.

A large scale plan of the site of the explosion is given in Appendix IV.

A table of measurements of craters and a scale plan and elevation of the crater where No.5 Mixing House stood is given in Appendix V.

Photographs of the craters and damaged buildings are given in Appendix VI.

2. Examination of the Scene of the Accident.

The Court viewed the scene of the explosion on the morning of the 19th January, when the following facts were observed :-

(a) No.5 Mixing House.

There were two separate craters (as shown on plan, Appendix V) suggesting by their position and shape that the passage to the river had contained bags ready for the arrival of a boat and that other bags had also exploded in the body of the building whilst standing in their proper place near the radiator.

The crest of the crater was seen to contain many large chunks of concrete which had been the facing of the traverse wall. Some of these chunks were thrown distances of two or three hundred yards.

(b) No.18 Stove.

Nothing at all remained of the building. There was merely a circular crater, the leaden floor being pushed into a saucer shape and torn into fragments.

(c) No.14 Stove.

The floor of this stove was in much the same condition as No.18 but as this building was only traversed on the north and south sides the blast on the untraversed sides had been able to do considerable damage on the west to No.4 Mixing House and the acid factory beyond, while on the east No.18 stove and the guncotton truck had been situated.

(d) Guncotton Truck.

The crater of this explosion was not directly under the track of the lines but was made some feet to the east which suggests that the truck had been overturned, for example by the blast from No.5 Mixing House or No.14 Stove, before detonating. It is evident that the truck was being pushed northwards by the two men who were killed. Their bodies were found lying full length face downwards some 12 to 18 feet east of the crater with their feet in the direction of No.18 Stove.

- (e) The Court then inspected the remains of No.19 Stove which was burnt out, and No.2 Weighing House which was practically destroyed by blast. (See Appendix VI for Photographs). They also visited Nos.1 and 2 Washing Houses, both of which were in use at the time of the explosion.

In No.2 Washing House an operative was still washing Nitro Glycerine which, as the usual services were cut off or seriously interfered with, required very careful attention. Both these buildings themselves were in a partly shattered condition.

- (f) It was observed in the vicinity that timber and debris had been scattered generally up to about 100 yards radius, and occasionally to greater distances. Generally speaking windows and doors were blown out up to 200 yards away, the distance varying with the intervening protection of traverses and trees. The protection afforded by the former was very noticeable,

also by the latter when in sufficient quantity. Damage to glass was widespread, occurring as usual in "patches", many buildings comparatively near in the factory escaping unscathed whilst houses at distances of over a mile from the factory suffered extensively.

- (g) After inspecting the damage done to other Mixing Houses, the Wash Water Settling House, the Nitrating House, etc., the Court inspected the Acid Factory and outlying buildings connected with the Nitro Glycerine Section and noted that the damage to roofs, windows, doors, etc., was widespread particularly where a clear passage for the blast existed.

3. Evidence from Witnesses.

On reassembly the Court reviewed the possible causes of the explosion and called as witnesses all who might be able to give information which would enable the Court to assess the likelihood of the following having occurred :-

- i. Sabotage.
- ii. Abnormal Conditions.
- iii. Error of Judgment.
- iv. Faulty Plant.
- v. Faulty Procedure.
- vi. Impure Ingredients.

The Court was aware that a Chief Inspector from Scotland Yard had been conducting enquiries in the Factory for some weeks on behalf of the War Office in connection with several incidents which had occurred recently in the Cordite Section. The Chief Inspector was, therefore, called and he gave the Court an account of the conclusions to which his enquiries had so far brought him. From his statement it appeared that this explosion was in no way connected with the previous incidents and the Chief Inspector was asked to continue his investigations and inform the Court if any material evidence bearing on this explosion came to his knowledge.

The following witnesses were examined by the Court :-

Mr. H. Sellick	-	Managing Chemist, R.G.P.F.
Mr. McLintic	-	Chemist-in-Charge, Nitroglycerine Section.
Mr. Kavanagh	-	Shift Chemist, Nitroglycerine Section.
Mr. Houghton	-	Shift Chemist, Nitroglycerine Section.
Mr. Spencer	-	Foreman, Nitroglycerine Section.
Mr. Lawrence	-	Assistant Foreman, Nitroglycerine Section.
Mr. Sweetman	-	Stove Setter, Nitroglycerine Section.
Mr. Head	-	Boatman, Nitroglycerine Section.
Mr. Dunning	-	Chargeman of Stove Setters.
Mr. Salmon	-	B.W.D. Boatman.
Mr. Berry	-	Assistant Foreman, Nitroglycerine Section.
Mr. Hickman	-	Chargeman, Nitroglycerine Section.
Mr. Ince	-	Paste Truckman, Cordite Section.
Mr. Lewis	-	Chemist-in-Charge, Cordite Section.

Mr. Ella	-	Chargeman, No.3 Mixing House.
Mr. Stoner	-	Chargeman, No.2 Mixing House.
Mr. Pallet	-	Hillman on duty in Solution House.
Mr. Cordell	-	Foreman, Cordite Section.
Mr. Knapman	-	Superintendent, R.G.P.F.

A summary of their evidence is given in Appendix VII.

4. Discussion on the Evidence.

(a) Evidence as to the origin of the explosion.

The Court endeavoured to establish at which point the explosion originated but no direct evidence could be obtained. The area is mainly occupied by drying stoves and the few process houses there are surrounded by traverses. In addition the trees obstruct the view of any distant observer. In fact, as is not uncommon in such cases all the direct evidence was completely destroyed, the two truck men and the three operatives in No.5 Mixing House all being killed. Neither Chargeman Sweetman, who was working inside No.20 Stove, next adjacent to No.19, nor Chargeman Stoner, who was in No.2 Mixing House and was injured by the explosion, could give any indication of the direction of the first explosion.

The most valuable evidence was given by Boatman Head who saw the explosion from the far side of the C.E. Bridge and appeared to be certain that the subsequent explosions were on the right of the first one seen by him. This would indicate that the initiation took place either at No.5 Mixing House or No.14 drying stove. This suggestion is supported by certain circumstantial evidence. For instance the position of the bodies of the two truck men point to the probability of the blast striking them from the west. Also the bodies were found covered with debris probably from No.18 Stove, which suggests that that was the last to explode. The fact that the bodies were intact rules out the possibility of the content of the truck having detonated first. There was nothing to suggest that the truck had left the rails accidentally and evidence was given that the track was in good condition at this place.

(b) Evidence on the possible causes of the accident.

I. Throughout the examination of the witnesses nothing was revealed which might give rise to the suspicion of sabotage and although it must be remembered that all the best direct evidence had been destroyed it is considered most unlikely that a saboteur would go to the extent of destroying his own life to achieve his object, while sabotage action in safety is considered to be unlikely in view of the condition of the contents of the Stove at the time. The mixing house from its position and construction could not be interfered with from outside sources and as far as factory workmen themselves were concerned, as the explosion occurred about half way through a shift, no one would be in a position to act maliciously without almost involving himself in the catastrophe.

II. The extreme cold prevailing at the time of the accident suggests a possible cause. The outside temperature on the morning of the accident was 15°F. Exhaustive evidence was taken and witnesses carefully

examined with the object of ascertaining whether nitroglycerine had been known to freeze when handled under the conditions then prevailing and whether operatives were aware of the danger involved and knew the proper action to take should this happen. Evidence showed that the procedure for dealing with frozen nitroglycerine was laid down (see Special Rules for Mixing House, Appendix VIII). On the other hand it will never be known whether any of the three operatives in No.5 Mixing House had met with frozen nitroglycerine and had failed through inexperience or carelessness, to comply with the rules. The Court made careful enquiries in an endeavour to establish the time which elapsed between the nitroglycerine bags leaving the pouring on house and their arrival at the Mixing House, and the minimum time which a bag might remain in the Mixing House, before being mixed. There appears to have been some delay that morning owing to ice on the canal and it would seem that some of the 30 bags loaded at No.3 Pouring on House might have remained on the boat for a longer time than usual before being delivered at No.5 Mixing House. The evidence was conflicting, but it seems that the boat took over an hour between arriving at No.2 Mixing House and reaching No.5 Mixing House. The normal procedure is for poured on bags to be placed on the floor near a radiator beside which a line is painted to indicate the minimum proximity at which bags are to be placed. The semi-circular crater formed by the explosion suggests that this procedure had been followed wholly or in part. It was also learned that should the stock of poured on bags in the Mixing House be low newly delivered bags would be worked with very little delay after arrival.

It was remarkable that with one exception no witness had any first hand experience of bags of frozen nitroglycerine on guncotton. No one was able to give a certain or accurate description of its appearance, while one witness with 46 years service at Waltham had never seen any there, though he had once seen frozen paste at Gretna. It is, therefore, to be a matter for conjecture whether an operative would recognise frozen nitroglycerine on guncotton.

III. With regard to the temperature of the building the Chemist, Nitroglycerine Section, testified that temperatures were examined daily in all Nitroglycerine Buildings before work began and that if the temperature were below 10°C. the matter would be reported at once and work would not start. This evidence was confirmed by the Hillman whose duty it was to examine each building. Usually he made a written report that everything was correct and although on this occasion he admitted that owing to pressure of other work he omitted to make the report, yet the Chargeman actually working in an adjacent Mixing House said he had examined the temperature himself in his own building, and it was well up to normal. Assistant Foreman Lawrence, also confirmed that each Chargeman made it his business to satisfy himself that temperature were correct on taking over his duties. It is to be noted that the position of the thermometer is on a level with the eye and there might, therefore, be a difference between the floor temperature and that registered by the thermometer.

Witnesses, however, confirmed that the river doors, also the doors leading to the shoe porch, were invariably kept closed in cold weather. One witness stated that the floors (lead on concrete) were very cold.

- IV. Evidence was taken on the condition of the ingredients, nitroglycerine, guncotton and their raw materials which were in the Stoves and the Mixing House, and a statement certifying that they were tested and found satisfactory is attached at Appendix IX
- V. Evidence was heard that all the buildings concerned in the explosion had received proper periodical examination and that they all were in good structural condition.
- VI. The possibility was considered of an electrical discharge having taken place in a stove. Witnesses explained the earthing arrangements and it was also stated that all electric lights were outside the buildings. Further, none of the Stoves was in a condition liable to static charges at the time of the explosion, and a static discharge would be most liable to occur when the guncotton primers were being handled.
- VII. There being no moving plant in No.5 Mixing House or in any of the Buildings concerned, there could be no question of any mechanical defects. The Mixing Tables were part of the floor as absolute fixtures and the radiator cover was also carefully soldered to the floor and was frequently examined for any possibility of a crack where guncotton might be harboured.
- VIII. In order to try and assess the likelihood of nitroglycerine on guncotton becoming frozen the Court heard evidence on the behaviour of paste in this respect, i.e. mixed nitroglycerine and guncotton. The freezing of paste appears to be a very rare occurrence, the Chemist, Cordite Section, had never seen it during his five years experience, and a Foreman of the same Section had never seen it at the R.G.P.F. during 46 years experience, though he had met it elsewhere.
- IX. To assess the likelihood of faulty handling evidence was taken on the general standard of knowledge, skill and experience of the staff and operatives. The Court was told that operatives for the Nitroglycerine Section, where the highest wages were paid, are carefully selected from men employed in other Sections so that the standard in this Section should be higher than elsewhere. The recent large expansion and the provision of nucleus staffs for new factories has resulted in a serious depletion of trained personnel not only in process workers but amongst the services, particularly amongst the plumbers. This shortage handicapped the training of new entrants as well as the progress of production. When asked whether his staff was being depleted beyond the danger point the Superintendent was

guarded in his reply but gave the impression that the matter was causing him some anxiety.

X. At the request of the Court the Inspectorate of Explosives, Home Office, obtained from the Meteorological Office a report on the seismograph record obtained at Kew Observatory of the accident. This is attached at Appendix X. From this report the time of the explosion can be fixed at 10.42 30 ± 2 seconds. Also it suggests that a second shock of much less intensity occurred about 5 seconds later. The greater intensity of the first shock would be consistent with the detonation of explosive in contact with the ground as would be the case if No.5 Mixing House had exploded first.

XI. During the proceedings of the Court information was received relating to the conduct of three men which formed the subject of a Memo. addressed to the Director of Ordnance Factories by the Superintendent, R.G.P.F. Appendix XI. The Court were glad to endorse this recommendation as in Appendix XII.

5. Conclusions.

(a) Probable Origin of the Explosion.

The Court consider that the most probable origin of the Explosion was at No.5 Mixing House. The reasons for this are :-

- (i) The general evidence points to the first Explosion having started either in this building or No.14 Stove.
- (ii) No operational work was in progress in any other building.
- (iii) The Kew Observatory report supports this supposition.
- (iv) It is not to be expected that Guncotton which had passed through the whole of the drying and cooling cycles and was known to be of good stability, would be likely to ignite spontaneously.

The Court cannot discover sufficient evidence to enable them to offer an opinion on the subsequent sequence of explosions.

(b) Possible Causes of the Explosions.

- i. Sabotage. The possibility of this cannot be entirely excluded, but nothing is disclosed that gives rise to the suspicion of this having taken place.
- ii. Abnormal Conditions. The Court strongly favour the theory that the accident was probably caused by the presence of frozen nitroglycerine due to the intense cold. In this connection it is interesting to note that experiments carried out by the Research Department show that a mixture of liquid and frozen nitroglycerine is possibly more sensitive than isolated frozen nitroglycerine.

- iii. Error of Judgment. Coupled with the theory that the accident was possibly caused by the presence of frozen nitroglycerine, it is reasonable to think that it may have been caused by some failure in procedure on the part of the operatives. The chargeman in this house was well spoken of by his Foreman and although the other two men were considered to be quite reliable they were both men of very short experience.
- iv. Faulty Plant. Owing to the extremely limited nature and the absence of loose plant, the possibility of an accident due to this is considered to be very remote.
- v. Faulty Procedure. The control of the boat transport appears to allow of delay in the passage of nitroglycerine, with its consequent long exposure to cold in winter time.
- vi. Impure Ingredients. Evidence shows that the Ingredients were up to Specification.

6. Recommendations.

*Open canal
Truck line to 9th Store
with buckets this bit
Packs must be delivered
to 2 Stores sometimes
New thermometer at
MTC office.*

(a) Transport. Measures should be introduced to ensure the quick boat transit of Nitroglycerine poured on Guncotton and Paste at all times, and with this object no boat should be allowed to make intermediate calls on its journey.

(b) Air Temperature. That should the outside temperature fall below freezing point it should be made the duty of selected responsible officials to warn all operatives to be on their guard against possible freezing of nitroglycerine.

*Special
Rules to be
examined &
improved.*

(c) Special Rules. The Court consider that the Special Rules should be examined to ensure that their intention is clear and that they are understandable by the operatives; thus a short explanation of the nature of frozen Nitroglycerine or Paste would assist the operative in identifying it and in taking the action laid down in the Rules.

7. Observations.

to be done.

(a) The Court consider that steps should be taken to investigate the difference in temperature between the wall thermometer and the ground level of the house and porch to ascertain whether there is the possibility of the latter two falling to a dangerous degree while the wall thermometer is still registering the specified temperature.

(b) The rapid expansion in production from the abnormally low peace rate has resulted in a great scarcity of trained staff which has seriously handicapped the proper training of operatives. The Court desire to invite attention to the need for maintaining a nucleus of trained and skilled staff in peace time to provide

an adequate body for expansion on emergency, and in view of the still greater requirements of the near future, the training of additional staffs should be given immediate consideration.

- (c) The fire fighting staff functioned satisfactorily and the general behaviour of the operatives on the scene was extremely good.
- (d) The Court suggest that a letter of appreciation be addressed to the Vicar of Waltham Abbey for the assistance he gave in communicating the news to the relatives.
- (e) The Court consider that the very small casualty roll caused by what must be regarded as a major explosion can be attributed very largely to the satisfactory layout of the factory, the excellent conduct of the staff and operatives and the well drawn up General Rules.
- (f) The Court is grateful for the attendance of a representative of the Explosives Branch of the Home Office, and valued the assistance that he gave.

PRESIDENT :- (Sgd.) J.C.E. Pellereau,
Lt.Col.

MEMBERS :- (Sgd.) H.A. Phillips.

(Sgd.) J.S. Mellor, Lt.Col.

(Sgd.) A.S.T. Godfrey,
Capt.

(Sgd.) R.P. Evans.

(Sgd.) T. Barratt.

(Sgd.) E. Garratt.

SECRETARIES :- (Sgd.) E.L. Blee, Lt.

(Sgd.) C.J. Haslar.

28. 2. 40.

TABLE OF APPENDICES.

- I - Particulars of the Explosive content of the Buildings and Truck destroyed by Explosion or Fire.
- II - Map of the district showing the degree of damage sustained.
- III - Approximate total damage.
- IV - Large scale Plan of site of the Explosion.
- V - Table of measurements of Craters and scale plan and elevation of Crater where No.5 Mixing House stood.
- VI - Photographs of the Craters and damaged buildings.
- VII - Summary of verbal evidence.
- VIII - Special Rules for Mixing Houses.
- IX - Statement certifying that all ingredients and raw materials were tested and found satisfactory.
- X - Report on the Seismograph record obtained at Kew Observatory of the accident.
- XI - Memorandum relating to the exceptionally good order and promptness of all in the vicinity of the Explosion, with Superintendent, R.G.P.F.'s recommendation regarding three of the operatives.
- XII - The Court's Endorsement of the above recommendation.

APPENDIX I.

Particulars of the explosive content
of the Buildings and Truck destroyed
by Explosion or Fire.

No. 5 Mixing House.	6000 lbs. Nitroglycerine poured on guncotton and mixed paste.
No. 14 Stove	5,200 lbs. dry guncotton, standing dry for 17 hours, cooling off.
No. 18 Stove.	5,200 lbs. guncotton, 37 hours drying.
No. 19 Stove.	5,200 lbs. guncotton, 23 hours drying.
Truck.	640 lbs. dry guncotton.

same total 10 tons

*28 | 640 (23 lbs)
56 4 (23)
80 6 cut
84*

1/2 tons 5 cut

*28 in - 2 cut 2240 | 5200 (2.32)
4 4480
20 2200
2240 6720
4800*

*28 4 cut
112 2
2240 2
2240 | 6000 (2.68)
4480
15200
13640
17600
17920*

*2.68
2.32
2.32
2.32
10.20*

*28 | 640 lbs
2240
2240*

THIS DRAWING OR DOCUMENT IS THE PROPERTY OF THE
MINISTRY OF SUPPLY and is entrusted in confidence to



who will be held responsible for its custody, and for taking all necessary steps to ensure that the following instructions are observed.

- (1) The drawing or document is to be used only in connection with Government work.
- (2) It is to be kept under lock and key when not in use and returned on completion of the work, or at any time on demand to the Chief Mechanical Engineer

() Royal Arsenal, Woolwich.

- (3) No copies or reproductions in whole or in part are to be made without the permission in writing of the Chief Mechanical Engineer, Royal Arsenal.
- (4) No more of the information contained in this drawing or document is to be disclosed to any person than is necessary to enable him to perform his share of the work arising therefrom.
- (5) If any information contained in this drawing or document is solicited by an unauthorised person, an immediate report is to be made to the Chief Mechanical Engineer, Royal Arsenal, Woolwich, giving all relevant particulars including, if possible, the name, address and occupation of the enquirer.

Note 1.—Attention is drawn to the provisions of the Official Secrets Acts as regards the unauthorised communication of confidential information.

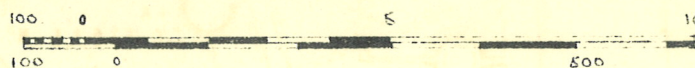
Note 2.—Any person other than the authorised holder upon obtaining possession of this drawing or document by finding or otherwise should forward it, together with his name and address, in a closed envelope, to the Chief Mechanical Engineer, Royal Arsenal, Woolwich. Letter postage need not be prepaid; other postage will be refunded.

All persons are hereby warned that the unauthorised retention, or destruction of this drawing or document, or the communication of any information contained therein, is an offence against the Official Secrets Acts.

(20248—59) Wt. P1548—0186 6000 10/39 P. St. G. 620

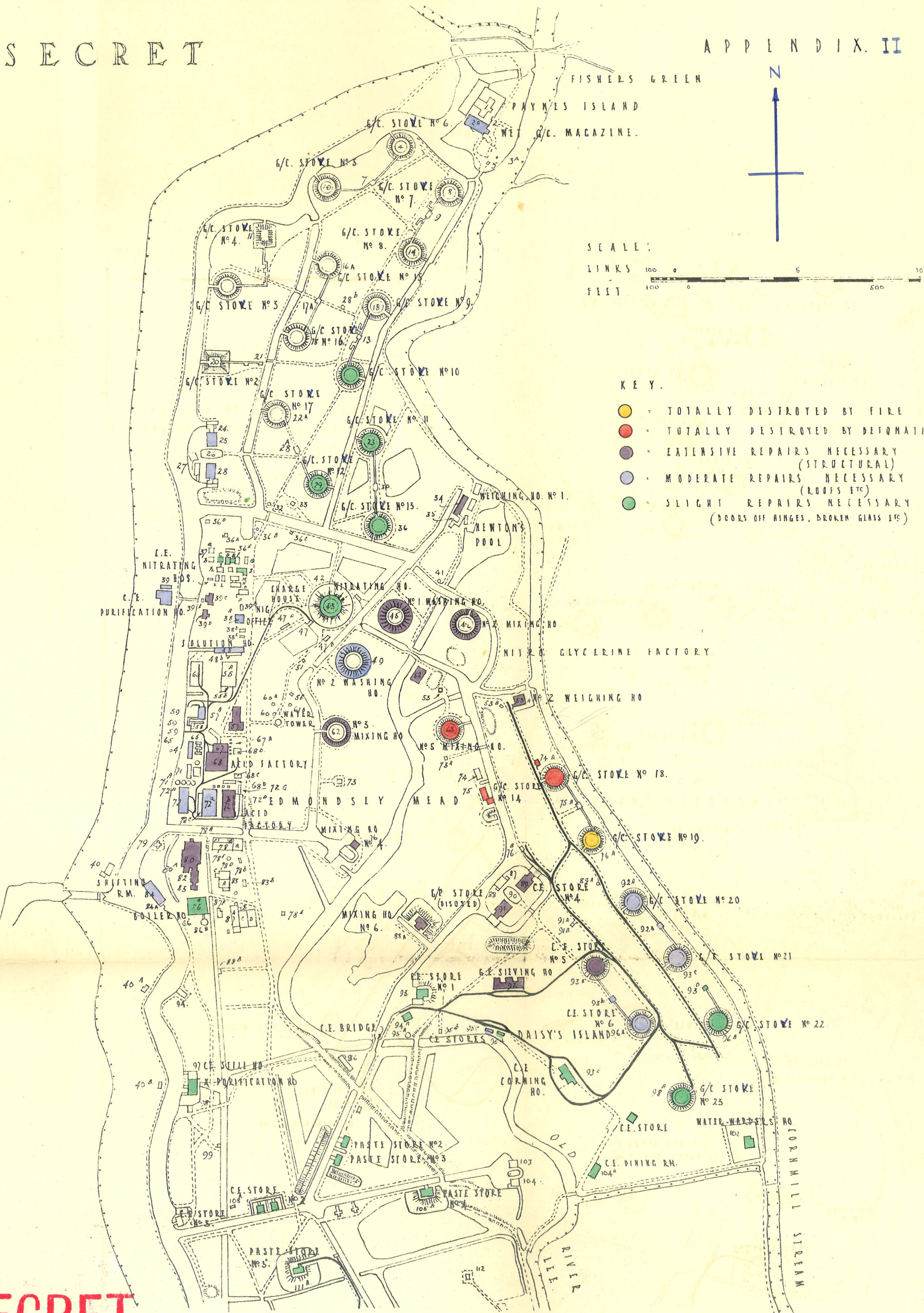
S E

LINKS
FEET



KEY.

- = TOTALLY DESTROYED BY FIRE
- = TOTALLY DESTROYED BY DETONATION
- = EXTENSIVE REPAIRS NECESSARY (STRUCTURAL)
- = MODERATE REPAIRS NECESSARY (ROOFS ETC)
- = SLIGHT REPAIRS NECESSARY (DOORS OFF HINGES, BROKEN GLASS ETC)



- KEY.
- - TOTALLY DESTROYED BY FIRE
 - - TOTALLY DESTROYED BY DETONATION
 - - EXTENSIVE REPAIRS NECESSARY (STRUCTURAL)
 - - MODERATE REPAIRS NECESSARY (ROOFS ETC)
 - - SLIGHT REPAIRS NECESSARY (DOORS OFF HINGES, BROKEN GLASS ETC)

APPENDIX III.

APPROXIMATE

TOTAL DAMAGE

ASCERTAINED 20/1/40.

Building No.		Construction	Damage	Extent
104.A.	Shifting Room	Weatherboarded and Felt roofing	Sides and roof.	Slight
93.F.	C.E. Stove No.3.	Asbestos lined on timber framing	Sides	Slight.
93.E.	C.E. Incorporating Ho.	Brickwork. Roof corrugated asbestos.	Walls and roof.	
95.D.	C.E. Clearing House No.2 Stove.	Weather boarded. Felt roofing.	Sides and roof.	Slight.
95.C.	C.E. Clearing House No.1 Stove.	Ditto		Moderate.
94.A.	C.E. Still House.	Weatherboarded, Roof felt.	Sides and roof.	Slight.
93	C.E. Packing House	Brickwork. Roof zinc.	Walls, roof.	Slight.
92	C.E. Corning Sieving House.	Brickwork, Roof corrugated asbestos.	Walls, roof.	Extensive.
93.A.	C.E. Stove No.5	Weatherboarded. Roof felt.	Sides, roof.	Extensive.
93.B.	Fan House	Weatherboarded. Felt roofing.	Sides roof	Slight.
96.A.	C.E. Stove No.6	Weatherboarded. Roof felt, match brick.	Sides and roof.	Moderate
	G/C Stove No.23 and Fan House.	Ditto and calico lined.	Sides and roof.	Slight.
96.B.	G/C Stove No.22.	Ditto and calico lined.	Sides, roof.	Slight.
93.D.	Fan House.			
93.C.	G/C Stove No.21.	Ditto and calico lined.	Sides and roof.	Moderate.
92.B.	Fan House.			
92.A.	G/C Stove No.20. Earth Closet.	Weatherboarded. Roof felt, calico lined.	Sides and roof.	Moderate.
93.B.	Fan House.	Weatherboarded, roof felt.	Sides and roof.	Moderate
	C.E. Stove No.3 Bldg.91 and C.E. Stove No.4.	Brickwork. Roof zinc.	Sides and roof.	Extensive.

Building No.		Construction.	Damage.	Extent.
46.	Mixing House No.2	Weather board. Roof zinc, match and zinc lined inside.	Sides and roof.	Extensive.
53.A.	Weighing House No.1.	Brickwork and weather boarded. Roof slates and zinc.	Sides and roof.	Extensive.
45.	Washing House No.1.	Weatherboarded, roof felt.	Sides and roof.	Extensive.
49.	Washing House No.3.	Weatherboarded, zinc roof.	Sides and roof.	Moderate.
62.	Mixing House No.3.	Weatherboarded Zinc roof.	Sides and roof.	Extensive.
43.	Nitrating House No.1.	Weatherboarded Zinc roof.	Sides and roof.	Slight.
36.	G/C Stove No.35	Weatherboarded Zinc roof.	Porch doors	Slight.
76.	Mixing House No.4.	Weatherboarded Roof felt.	Sides and roof.	Extensive.
	N.G. Strappers Hut.	Weatherboarded Roof felt.	Sides and roof.	Slight.
37.F.	Picrite Milling House.	Weatherboarded Roof felt.	Sides and roof.	Slight.
	Clock Station	Weatherboarded Roof felt.	Sides and roof.	Slight.
37.D.	C.E. Filter House.	Weatherboarded Roof felt.	Sides and roof.	Slight.
37.C.	C.E. Nitrating House No.1. Annexe to above. C.E. Nitrating House No.1.			
37.K.	C.E. Nitrating House No.4.	Corrugated iron sides roof.	Sides and roof.	Slight.
37.L.	C.E. Nitrating House No.5.	Corrugated iron sides roof.	Sides and roof.	Slight.
37.G.	C.E. Nitrating House No.6.	Corrugated iron sides roof.	Sides and roof.	Slight.
39.	C.E. Purification House.	Corrugated sides and roof.	Sides and roof.	Moderate.

Building No.		Construction	Damage	Extent
39.D.	Picrite Purification House	Corrugated sides and roof.	Sides and roof.	Moderate
	C.E.drying stoves.	Insulwood Roof felt.	Sides	Slight
39.C.	Main Picrite House	Corrugated sides and roof.	Sides and roof.	Extensive
38.A.	N.G. Office	Brickwork. Slates roof.	Roof, sides and ceilings	Moderate.
38.	Solution House	Weather boarding Roof slates	Sides and roof.	Moderate.
	New Refrigerating House.	Corrugated sides and roof.	Sides.	Slight
55.A.	Earthenware Stove.	Brickwork. Roof felted	Roof and Sides.	Extensive
57.C.	Cascade House.	Brickwork. Roof tiled.	Roof and sides.	Extensive
56/57.H	Plumbers Shop	Brickwork. Roof slates and zinc.	Roof and sides.	Moderate.
64.	Acid Concentrating House.	Brickwork. Roof slates.	Roof and sides.	Moderate.
72.	Glycerine House.	Brickwork, slates roof.	Roof and sides.	Moderate.
67/68	Nitric Acid Factory	Brick walls. Roof slates and tiles.	Roof mainly.	Extensive
72.A/D.	Nitric Acid Factory.	Corrugated sides Roof felted.	Roof	Moderate
	Engine and refrig. room.	Brickwork. Roof slates.	Sides and roof.	Extensive.
80.	Boiler House No.1	Corrugated sides Roof slates.	Roof	Extensive
80.A	Boiler House No.2	Corrugated sides Roof slates	Roof.	Extensive
84.	N.G. & C.E. Shifting Room.	Brickwork. Roof slates	Sides and roof.	Moderate.
	Boiler House No.3	Corrugated sides and roof.	Sides and roof.	Slight
87.	N.G.Shifting and Dining	Weather boarding Roof felted.	Sides and roof.	Extensive
	Hose House.	Weather boarded Roof felt.	Sides and roof.	Slight.

Building No.		Construction	Damage	Extent
88	Mixing House No.6	Brickwork. Roof felt.	Sides and roof.	Extensive.
96	Dining Room.	Brickwork. Roof slates.	Sides and roof.	Slight.
98	C.E.Purification No.1.	Asbestos lining on steel framing.	Sides and roof.	Moderate.
98	C.E.Purification No.2.	Asbestos lining on steel framing.	Sides and roof.	Moderate.
B.2.A.	Wet G/C Magazine.	Asbestos lined. Roof tiles.	Sides and roof.	Moderate.
102	W. Warder's Cottage.	Brickwork. Roof tiles.	Roof	Slight.

Note :-

The buildings enumerated in lists are exclusive of those requiring complete renewal.

No.18	G.C. Stoves	74.A.
No.19	G.C. Stoves	76.A.
No.14	G.C. Stoves	75

Wash Water Settling House	52
No.2 Weighing House	53.A.
Clean Store (N.G. Tool).	53

No.5 Mixing House not mentioned in above as possibility of not being replaced.

(Sgd.) E.F. Upton.

23/1/40.

who will be held responsible for its custody, and for taking all necessary steps to ensure that the following instructions are observed.

- (1) The drawing or document is to be used only in connection with Government work.
- (2) It is to be kept under lock and key when not in use and returned on completion of the work, or at any time on demand to the Chief Mechanical Engineer

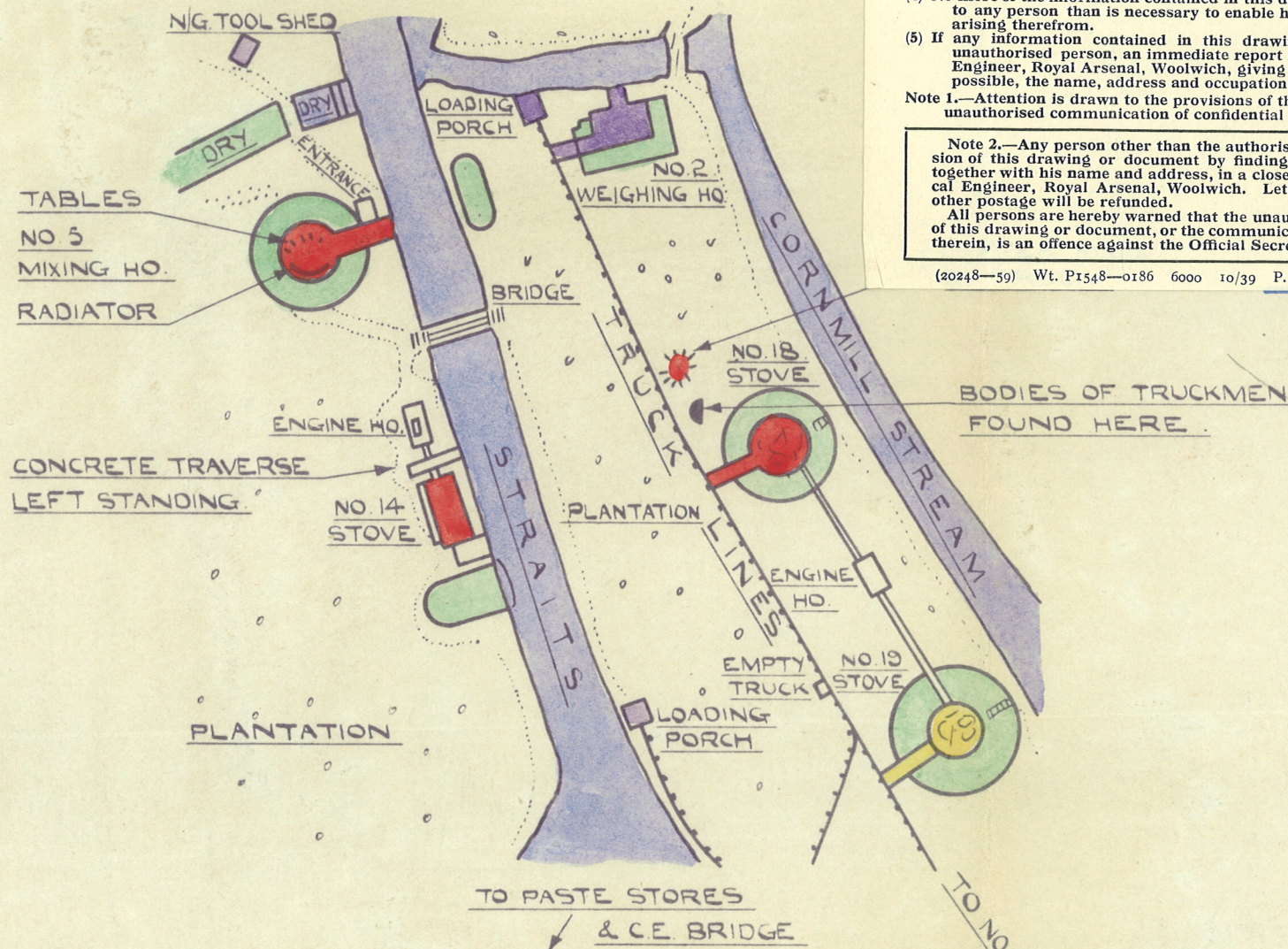
() Royal Arsenal, Woolwich.

- (3) No copies or reproductions in whole or in part are to be made without the permission in writing of the Chief Mechanical Engineer, Royal Arsenal.
- (4) No more of the information contained in this drawing or document is to be disclosed to any person than is necessary to enable him to perform his share of the work arising therefrom.
- (5) If any information contained in this drawing or document is solicited by an unauthorised person, an immediate report is to be made to the Chief Mechanical Engineer, Royal Arsenal, Woolwich, giving all relevant particulars including, if possible, the name, address and occupation of the enquirer.

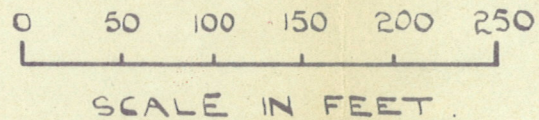
Note 1.—Attention is drawn to the provisions of the Official Secrets Acts as regards the unauthorised communication of confidential information.

Note 2.—Any person other than the authorised holder upon obtaining possession of this drawing or document by finding or otherwise should forward it, together with his name and address, in a closed envelope, to the Chief Mechanical Engineer, Royal Arsenal, Woolwich, giving all relevant particulars including, if possible, the name, address and occupation of the enquirer. Letter postage need not be prepaid; other postage will be refunded.
All persons are hereby warned that the unauthorised retention, or destruction of this drawing or document, or the communication of any information contained therein, is an offence against the Official Secrets Acts.

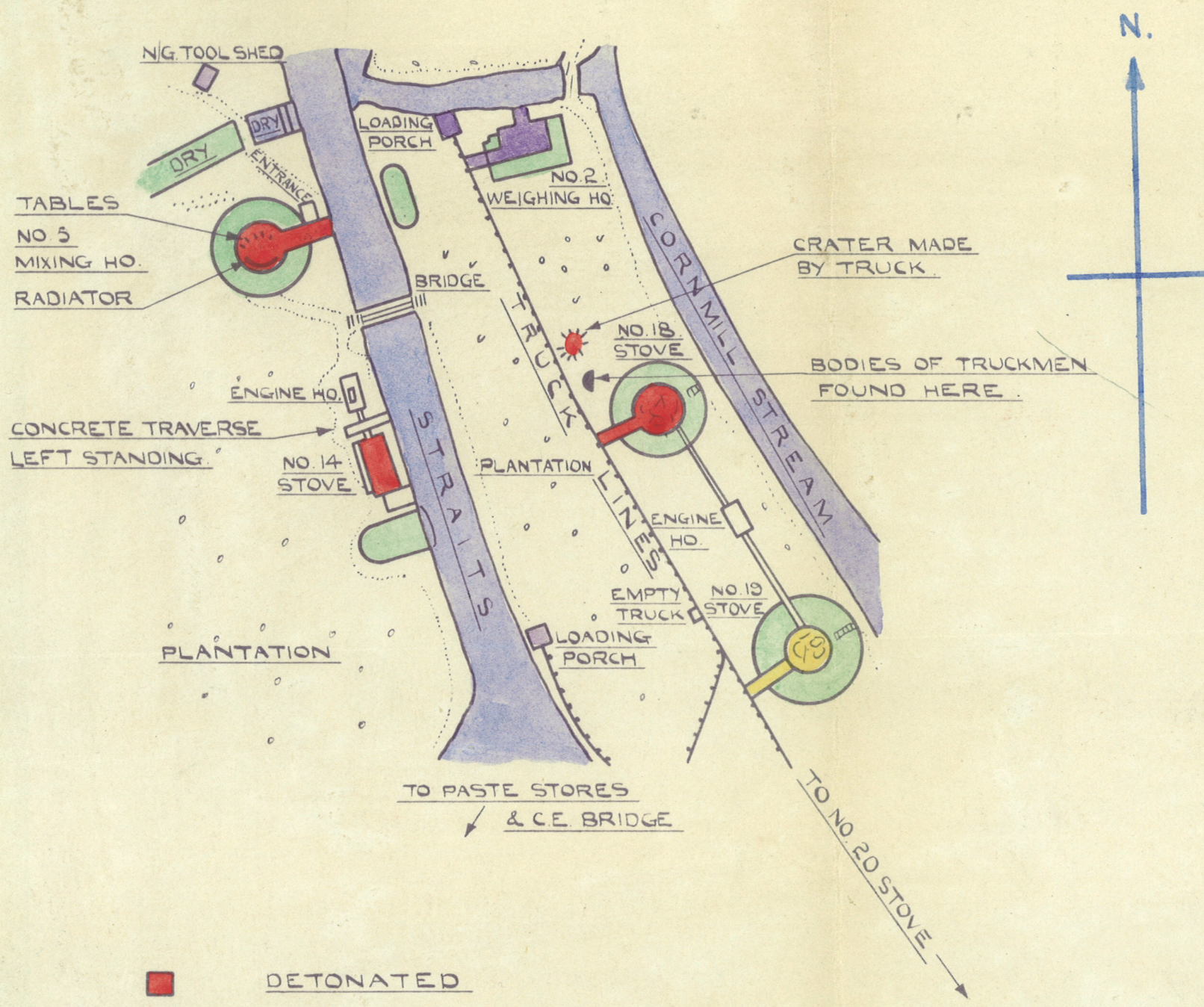
(20248—59) Wt. P1548—0186 6000 10/39 P. St. G. 620



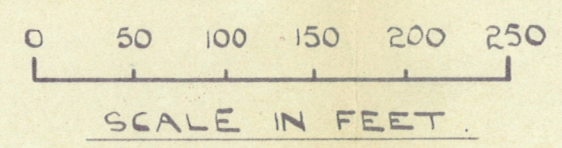
- DETONATED
- BURNT
- DESTROYED BY BLAST
- GRASS MOUNDS
- WATERWAYS



SECRET



- DETONATED
- BURNT
- DESTROYED BY BLAST
- GRASS MOUNDS
- WATERWAYS



SECRET

Appendix V with Plan

Measurements of Craters etc., taken
with Mr. Peterson, B.W.D. 23/1/40.

No.18 Guncotton Stove

Total diameter, crest to crest..... 60 feet.
Floor 30 feet
Depth from crest to centre..... 6/7 feet.

Crater almost exactly circular, floor being forced down into concave shape rather like a saucer.

Truck Crater.

Total diameter, crest to crest 12 feet
Maximum depth from ground level..... 3 ft. 3 in.

Centre of crater about 6 feet from railway line. Bodies of truckmen about 18 feet from truck crater. They were lightly buried and hole remains from which they were dug.

No.14 Guncotton Stove.

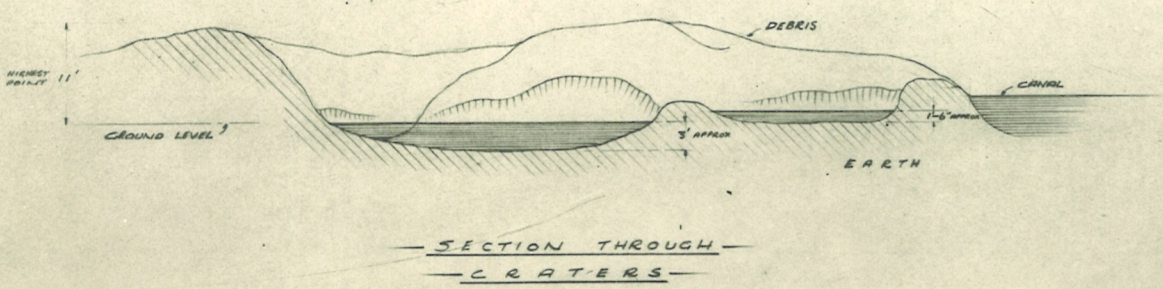
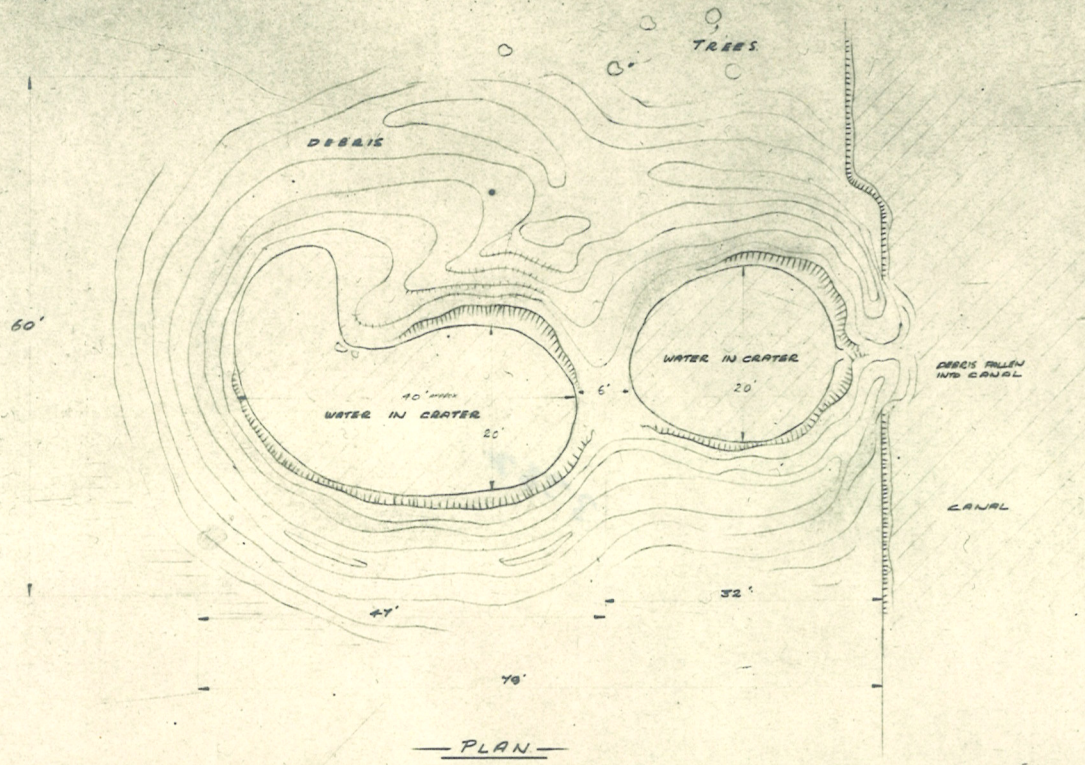
No crater at all. From plan it will be seen that building was only traversed at either end. These two traverses consisted of concrete wall at North end and earth mound at South end. Both remained unaffected except that concrete traverse wall had sprung slightly at the base. These traverses had evidently induced the explosion to spend its force East and West where there was no obstacle apart from trees.

No.5 Mixing House.

See Plan and elevation attached for full measurements.

MIKING HOUSE NUMBER 5.

PLAN & SECTION OF CRATERS CAUSED BY EXPLOSION



SECTION THROUGH
CRATERS

SCALE $\frac{1}{2}'' = 1'-0''$

APPENDIX VI

PHOTOGRAPHS

APPENDIX VII.

SUMMARY

OF

VERBAL EVIDENCE.

Summary of Verbal Evidence.

1st Witness - Mr. H. Sellick - Managing Chemist, R.G.P.F.

Mr. Sellick gave a brief outline of the processes concerned in that part of the factory where the explosion occurred. He explained how wet guncotton is received from the Guncotton Factory in Lorries. It is packed in aluminium boxes and is in the form of compressed cylinders. These are stacked on racks in the Stoves and are dried by hot air. The usual time of drying is about 60 hours, and after it has cooled the dry Guncotton is put into bags and removed to the Weighing House. There it is weighed into proper quantities and sent to the "Pouring-on House" where N/G. is added, but the two ingredients have still to be mixed and so the bags of "poured-on" Paste are sent to a separate Mixing House for this purpose. Mixing is carried out by rubbing the "poured-on" Paste through a 1/2 inch copper sieve and it then becomes "Mixed Paste".

If any foreign matter were in the cylinders of Guncotton it should be noticed first in the Mixing operation, or if not then at the loading of the Incorporating Machine, or finally at the Press House.

Mr. Sellick said that he was in his office when the explosion occurred and there was more than one report. He went at once to the scene but saw nothing to enable him to form an opinion as to which building exploded first.

With regard to the buildings themselves Mr. Sellick explained the construction of the Stoves, how one was lined with zinc and two others with calico, the floors all being of lead laid on concrete.

The Mixing House also had a lead floor and was zinc lined; it had a covered radiator and leaden tables for mixing the Paste, the legs being earthed. The operatives wore socks on account of the sensitiveness of Dry Guncotton, the Mixed Paste being regarded as much less dangerous.

With regard to the stage of drying which had been reached in the Stoves concerned and the times taken in transporting materials, Mr. Sellick said the Section would be able to provide full information.

2nd Witness - Mr. McLintic - Chemist-in-Charge - Nitroglycerine Section.

Mr. McLintic stated that he had been in his present position since the end of September, 1939, but had been a Chemist in the N/G. Section since 1936. He had no special reasons for suspecting any particular House of exploding first, but had formed an idea that it was No. 5 Mixing House. He was in the Cordite Section at the time, but had left Mr. Kavanagh and Mr. Houghton on duty in the N/G. Section. Questioned with regard to frozen N/G., witness stated that any case would most certainly be reported to a Chemist, and it would also be reported should the temperature of any House fall below 10°C. It was a Special Rule that should the temperature fall below 10°C. work must be stopped.

/Mr. McLintic.

Mr. McLintic stated that it was the normal procedure to bring unmixed material right into the body of the Mixing House straight away, but when the mixed paste was produced, that was stood in the tunnel whilst waiting for a boat to collect it. He explained that the unmixed paste is in rubberised bags, and the mixed is put into calico bags. The bags are made to specification.

The witness explained how tests were made of all materials which went to the making of Paste, before they were used, with the exception of the N/G. itself, samples of which could not be available until subsequently, without holding up the process. Samples were, however, always taken, and the results would be available in the Laboratory and examined before Paste was passed on to the Cordite Section.

Various questions were asked with regard to the Stoves and the witness was able to explain that the length of time required for drying might vary in each of them, but the average time was round about 60 hours.

He did not consider there was any great risk attached to the drying process as the racks are all earthed and tested periodically.

With regard to the shape of the crater formed by No.5 Mixing House, Mr. McLintic said this was easily explained, and demonstrated the position occupied by the radiator and the mixing tables. He also described the customary position of the bags and it was shown that in this way the craters were just what might be expected.

Points were raised with regard to the inspection of bags, the possibility of foreign bodies being introduced at the Pouring-on House, and it was stated that bags were always subjected to careful inspection, and although it would not be impossible for foreign matter to be introduced, and although such a thing was, of course, most undesirable yet the danger arising from it might easily be exaggerated. It was a thing that occasionally happened, that small pieces of wood or copper wire were found in the mixing process, presumably they came from the Stove.

Questioned with regard to the construction of the buildings which had exploded, the witness explained the procedure, and how at regular times all such buildings came in for very careful inspection, not only by himself, but also one of the Danger Building Inspectors.

No.14 is an old Stove and Nos. 18 and 19 have been in use a considerable time.

3rd Witness - Mr. Kavanagh - Shift Chemist - Nitroglycerine.

Mr. Kavanagh explained that he was a Chemist in the N/G. Section and had been in the Factory since November, 1936. He had been helping in the day work for some time as Mr. Lewis was shortly going to Scotland and Mr. McLintic would be vacating his position as N/G. Chemist in order to take over the Cordite Section.

Mr. Kavanagh was walking between Nos. 1 and 2 Washing Houses and within 70 yards of No.5 Mixing House when the explosion occurred. He heard two bangs close together then a smaller one and another at the end. He proceeded to the Stoves and saw one burning (No.19) and saw that steps were being taken to deal with the fire.

/He

He had no idea which house went first, as although very close he had the Washing House between him and the explosions. The witness was quite certain that all buildings concerned were structurally sound and in good order in every way. Questioned with regard to the possibility of any of the material freezing, he said in his opinion there was such a possibility, although he seemed to think it unlikely. In the event of any such freezing he stressed the fact that the rules are very definite on the subject, and that an immediate report should be made to a Chemist before anything was done. He had known cases of frozen N/G. - there was a case of it on the floor of the Nitrating House some time ago, caused by a draught, and in this case he admitted the possibility of bags freezing in transport with weather conditions as they are.

Should frozen poured-on material by any chance find its way into a house, Mr. Kavanagh pointed out that rules were posted up and read regularly to the men, which were very definite on this point, and, asked whether they would recognise frozen material if they saw it he said that Lawrence the Chargeman, was a very reliable man, and in any case if the material were frozen the men would be unable to pass it through the sieves in the tables.

A copy of the Special Rules for Mixing Houses was then produced and examined, Appendix VIII.

Asked whether he had any special ideas about the accident Mr. Kavanagh said there might have been some Guncotton harboured, or a foreign body might have been introduced. Such a thing would certainly be regarded as serious, but as to the possibility of its causing an explosion, although it was known that N/G. could be detonated between steel and phosphor bronze, yet a good blow would be necessary to do it. It seemed clear from his previous remarks that he rather suspected frozen N/G. as the cause, and when asked this by the President, he did not deny it.

The witness confirmed that searching was going on systematically and to the best of his knowledge, satisfactorily, so that it would be extremely difficult to take anything into a building. Finally it was stated that each house had an authorised list of tools which must be strictly adhered to. This contained no brooms, as flannels are used for cleaning purposes.

4th Witness - Mr. Houghton - Shift Chemist - Nitroglycerine.

Mr. Houghton stated that he had been Shift Chemist for nearly two years. When the accident happened he was in the Acid Factory and being inside the building he did not see any flashes nor could he give any evidence as to the position of the explosions except their general direction. The second one seemed the louder. He immediately left the Acid Factory and went to the N/G. Hill where he found two men and everything apparently intact. He also found No.2 Washing House still more or less in order and on meeting Assistant Foreman Berry discovered exactly where the trouble had occurred. He then went along past the remains of the Wash Water Settling House and saw large holes where No.5 Mixing House had stood, but realizing there was nothing to be done there he returned to the Hill to keep an eye on things there.

Asked with regard to the possibility of frozen N/G. being present in the Mixing House, Mr. Houghton, gave it as his opinion that in the boating there was a chance of such a thing happening in such exceptional weather, although he pointed out that the time from the loading to the unloading of the boat would not be very great. Should a thing happen to any of the bags they should still have time to warm up in the house before they were used.

/With

With regard to the construction of the houses the witness explained that No.18 Stove he knew, was in good condition, although being made during the last war it was lined with calico for economy, and this was liable to split and secrete Guncotton. It was regularly inspected for such faults, however, and repairs were carried out when necessary.

No.14 Stove, one of the oldest, was a zinc building and in good condition, though it was a bad stove for drying, and went rather longer than the others. No.5 Mixing House he knew to be in good condition, and he mentioned that the N/G. Buildings were all examined by one of the Chemists at least once a month.

Asked further with regard to the possibility of freezing, Mr. Houghton said if cases had occurred he would have heard about it as men have instructions to do nothing with the material and to report the matter.

A question was raised as to whether it were possible for a bag of poured-on Guncotton to make 2 journeys in a boat through being overlooked when the boat was unloaded on the first trip. Mr. Houghton did not think so, he pointed out that bags are 2'6" in diameter and one could not be missed on a small boat. As to the possibility of men loading a boat and going for a meal, Mr. Houghton said it could not have occurred in this instance, neither could it have happened at the end of a shift. Mr. Houghton also drew attention to the interesting fact that the boat got to the Mixing House half an hour before the explosion occurred, which meant that there would be plenty of warm material available at that time.

With regard to "limits" of explosives, the witness said he had never known them to be exceeded in the N/G. section.

5th Witness - Mr. Spencer - Foreman - N/G. Section.

Mr. Spencer stated that he had been Foreman of N/G. Section just over a year but he had been connected with the Section since 1899, when he was on acid work. He went on to N/G. manufacture in 1911.

He spoke well of Chargeman Lawrence, who was in charge in No.5 Mixing House, and said he knew his work well, having had much longer experience than the others. He had been in the N/G. Section for 18 months whilst the others had only been there, Purkiss from 29/9/39 and Parkes from 12/12/39. He explained, however, that it was the custom for men in the N/G. Section to be recruited from the Cordite Section and only those men were passed on to N/G. who were found thoroughly reliable. Mr. Spencer explained the difference between the various Mixing Houses, how some had appliances for pouring on the N/G. into the Dry Guncotton and also had tables for the mixing process whilst other Mixing Houses had only the tables in them, and received from the pouring-on Houses the materials on which they had to work. No.5 Mixing House was one of the latter type.

At the time of the explosion, witness was just about to enter the office on his return from the Hill. He had just previously visited No.5 Mixing House where boat was preparing to move off, after having delivered 60 bags of poured-on material, and taken up 60 bags of mixed paste.

Mr. Spencer thought there were four explosions which seemed to be in rapid succession, he rather thought there was a light explosion first, followed by three heavy ones. He immediately went to the scene of the trouble and found men

/hurriedly

hurriedly preparing to put out No.19 Stove, which was burning. Having seen that they were likely to get this under control, he went to see what other buildings were affected, and whether the Hill itself was safe. It seemed to him to be so, and he told the men to take no action until they received further orders from the Chemist-in-Charge. Witness said that he had no special ideas as to the possible cause but he pointed out the possibility of the truck having come off the rails. Questioned as to the weight of the truck and its business at that time, Mr. Spencer explained that the load was 640-lb., that is 16 bags, and it would be coming from No.20 Stove, which was in process of being unloaded.

The men pushing the truck were, Kelman and Robinson, and they were not experienced men as trucking is the first job that men are put to, as a rule.

Questioned with regard to the contents of other stoves concerned, Mr. Spencer explained that No.14 was standing dry, which meant that it was cooling off. No.18 was in process of drying and had run 37 hours out of a complete drying period of 55-60 hours. No.19 Stove had been more recently set, and had only run for 23 hours.

Mr. Spencer stated that after his long experience with N/G. his respect for it has increased rather than diminished, and questioned about the amount of experience of the men in the Section, it transpired that there were only three with really long experience, and with full qualifications for training others.

Mr. Spencer also mentioned that in addition to a good deal of inexperience in the Guncotton Section itself during this period of expansion, it was also a handicap to them that the Plumbers were in a similar plight. In the old days, he said, the Plumbers doing N/G. work never made mistakes, whereas new men, although they may be lead burners, are not able to, at first, appreciate the delicate nature of the work, which is necessary.

Asked whether he had had any reports of frozen paste, the witness answered in the negative, explaining that the Houses are in constant use, and as they were working three shifts are constantly warmed, there is also better radiation than there used to be.

Since he had been foreman he had no recollection of a case where Paste had been mishandled, and, if frozen poured-on Guncotton of any sort were observed, he felt sure the Chargeman of No.5 Mixing House would recognise it, although with Paste it would be harder to say.

With regard to No.14 Stove, Mr. Spencer pointed out that as this was cooling off it had passed any dangerous stage which might have existed previously, and it would be less likely to explode when it did, than when it had just finished drying.

With regard to No.18 Stove the temperature would probably be about 40° and the moisture content of the Guncotton 10% and he thought there was no reason for an explosion to start inside this stove.

Reverting to No.5 Mixing House again, Mr. Spencer explained that bags must not be put nearer the radiator than a white line, which is drawn 24" away.

6th Witness - Mr. Lawrence - Assistant Foreman - N/G Section

Mr. Lawrence was called first of all to give evidence merely as to where the explosions started, and he stated that he was at the half moon bridge between No.13 Stove and the Weighing House at the time, and was deafened in his right ear. He thought it was the Wash Water Settling House which had gone up as it seemed in that direction, but this evidence he admitted was not of much value, as he was shown on the map that the line of the Wash Water Settling House from where he stood, would cover both No.5 Mixing House and also No.14 Stove.

The witness was told he would be recalled for evidence on other matters later.

7th Witness - Mr. Sweetman - Stove Setter - N/G Section.

Mr. Sweetman explained that he was in No.20 Stove when the explosion occurred, but had no idea where the sound came from. He actually heard little sound, but felt the place shake very severely. He ran out and saw a cloud of smoke in the sky and No.19 Stove burning. This witness said he had previously loaded the Guncotton Truck which blew up. He described the method of loading and stated that the total amount was 16 bags totalling 640 lb. of dry Guncotton. He did not know the men, however, and they had passed no remarks of any importance whilst with him, but he knew it was Robinson's first time on the job. Guncotton Trucks had in his experience never come off the lines, and he knew of no case where material had been spilled from them.

8th Witness - Mr. Head - Boatman - N/G Section.

Before being questioned on other matters Mr. Head was first asked if he could give any evidence as to the order in which explosions took place.

He stated that he was with a boat on the far side of the C.E. Bridge at the time and there was a bang and he saw the flame. He could not see the Mixing House from where he was, but after the first explosion there was an interval of seconds and then another. The second explosion took place to the right of the first, from where he was standing.

9th Witness - Mr. Dunning - Chargeman of Stove Setters.

Mr. Dunning did not know where the explosions took place as he was not in a position to have a clear view, but he was thrown down by the blast. He said he heard three explosions in all and that the first came with more of a "crack" than the other two.

10th Witness - Mr. Salmon - B.W.D. Boatman.

Stated he was near No.1 Washing House at the time of the accident, breaking ice. The first explosion flung him and his mates off their feet, then there was a sheet of flame going up in the air, then the second explosion, the second being much louder than the first. He was actually behind the Washing House, and so the sound seemed to come from both sides. He saw that the men with him were all right and endeavoured to render general assistance. This witness had no suggestion to offer as to where the explosions first started.

11th Witness - Assistant Foreman Berry - N/G Section

Mr. Berry stated that there seemed to him to be two explosions from where he was, between the Nitrating House and the Solution House. He was thrown off his feet and on getting up

up thought that the Wash Water Settling House had gone up. He then ran into the Nitrating House - that being the most important place to receive attention - and having found no sign of immediate trouble, went to Nos. 1 and 2 Washing Houses to see that everything possible was being done to prevent further trouble there. He thought there was an interval of about 5 seconds between the two explosions.

12th Witness - Mr. Hickman - Chargeman - N/G Section.

Stated that he was in the Dining Room and heard two bangs with a space of about 3 seconds between. He has been trained as a fireman and made his way at once to Daisy's Island. There he found nothing left of the Mixing House or No.18 Stove but No.19 Stove still in flames. He helped to get the first body out from the place where the two truckmen were half buried. The bodies, he said, were on their faces with the feet towards No.18 Stove. They seemed to have been just blown down, and had the clothing still on them. They were about 4 yards from the crater, he thought, and parallel with the lines.

6th Witness (again).

Assistant Foreman Lawrence, on his return, stated that he was an Assistant Foreman and had been so for two days. He had been in the N/G. Section for 6 years and had had experience in all the various houses. Although he had been in the Mixing Houses quite a lot he had never found any frozen N/G. there. He had seen some in the river where he remembered it once got by accident. If he came across it he said, he would recognise it in the bags by the feel of it, and would not attempt to work with it.

Mr. Lawrence said his duties involved supervision of all operations and that he saw nothing unusual on the day of the explosions. The position of the thermometer, he said, was on the opposite side of the house to the radiator, and temperatures were taken each morning - both maximum and minimum temperatures. He agreed that the temperature would be colder in the tunnel but explained that river doors are always kept shut except when actually loading or unloading boats. He mentioned also that when dry G/C. is delivered to Pouring-on Houses, the bags are taken straight into the body of the house and after pouring on the N/G., the bags remain in the body of the house till the boat actually calls to take them away.

In the Pouring-on Houses, he said, a record is kept of the N/G. Charge No. and the Batch No. of the Guncotton. The witness did not know how long the boat takes from No. 2 and No. 3 Pouring-on Houses to No. 5 Mixing House, but said that it was not held up. He was at No. 5 Mixing House on the day of the explosion but did not go into the House. A boat delivered 60 bags of poured-on Guncotton just after 10.0 a.m.

Asked with regard to the N/G. which he had once seen in the river, he said it was at the bottom.

8th Witness (again).

On his return, Mr. Head said he had had a month's experience as boatman. The frost he reckoned made journeys take about twice as long as under good conditions. He took over the boat from Robinson and Kelman (who went trucking) at No. 2 Pouring House and considered it took 25 minutes from there to No. 5 Mixing House. He said it would never be possible to leave a bag in the boat because they were always looking for the last one. In fact when they came to it they often said "This is the one you're looking for."

In lifting bags he said they do not give much but that one would feel any hard lumps.

13th Witness - Mr. Ince, Paste Truckman, Cordite Section.

Stated he had been 6 weeks on his present job trucking from No. 5 Paste Store to Incorporating Houses and was before that in a Press House for about 5 weeks. He has been in the factory about 11 weeks. At the moment he was working under Chargeman Robinson.

He stated that he had often come across frozen N/G. in Paste but after remarking on the matter to Chargeman Robinson with some such remark as "Here are some lumpy bits again, Frank" the matter was ignored. He said that he had often known cases where Paste was taken direct from the boat (at the landing stage outside No. 5 Paste Store) to Incorporating Houses and suggested that boats were kept waiting for an hour or more. He also stated that trucks were kept waiting outside Incorporating Houses for about an hour and that trucks would quite frequently come off the lines, but added that this occurred at points.

14th Witness - Mr. Lewis - Chemist of Cordite Section.

Mr. Lewis stated that he had been in the factory for 5 years and always in the Cordite Section. With regard to the time during which Paste might be exposed to low temperature while being transported from place to place, he explained that in taking over Paste from the N/G. Section it was the practice to have it delivered at one of the Paste Stores nearer to the N/G. Section first of all, and finally to move it in a Cordite Boat to No. 5 Paste Store. It was from the latter store that the Incorporating Houses drew their Paste and it was only very exceptionally, and when there was a particularly heavy demand for Paste by the Incorporating Houses, that it would not have been in No. 5 Paste Store for some considerable time. He was able to say also that $\frac{3}{4}$ of an hour would be the maximum time which Paste would be in a truck. Boats from the N/G. Section were not under his control but he affirmed that they should not be held up at No. 5 Store for more than about 10 minutes. He said that there was nothing in the Special Rules of the Cordite Section with regard to frozen Paste and it must be a very rare occurrence as he had never seen any, and had no experience of it at all.

7th Witness (again).

Mr. Sweetman was recalled but gave no further evidence of any special interest.

15th Witness - Mr. Ella - Chargeman - No. 3 Mixing House.

Stated that he had been three years in the N/G Section. He was Chargeman in No. 3 Mixing House on the day of the explosions. He took the temperature on taking over the house, which was the first thing he always did, and he remembered it was 12° or 13°C . He poured on 30 bags which he understood were for No. 5 Mixing House, as well as about 45 bags to be mixed in his own house. He could not say for sure when the boat left with these bags, but he thought about 9.30. It would take about half an hour to pour on 30 bags.

He was knocked down when the explosion occurred, but being indoors had no idea which house went first.

/ 16th

16th Witness - Mr. Stoner - Chargeman - No.2 Mixing House.

Had been 4 years in H/G. Section and, before that, Boating etc. On the day of the explosions he went to the House and checked the temperature which was normal. He said that the boat arrived at 9.30, and he knew the time because there was a clock in the house which he consulted on this occasion. He also stated quite definitely, however, the time at which the boat left No.3 Mixing House, and the time at which it arrived at No.5 Mixing House, which of course he would not be in a position to know except by hearsay. This was considered to detract somewhat from the value of his other evidence.

He described the condition of the Guncotton dust on the Mixing House floor which he said he had known to be 1/4 of an inch thick.

With regard to the explosion, he stated that he was mixing and doing the last one when there seemed to be a blue flash and a terrific bang, the sound seeming to come from No.5. He was then on the floor and heard another explosion, not so loud as before. He only heard 2 reports. Mr. Stoner was then questioned with regard to the condition of boats. He said the ice caused them trouble and if they were wet inside, ice would form but he admitted that boats were kept dry inside with flannels provided, and that boats were cleaned before going to dinner and also at knocking off time.

He had never seen frozen N/G., though he had heard that it freezes very quickly at 50°F.

17th Witness - Mr. Pallet - Hillman on duty in Solution House.

Was working in the Solution House. He only heard one explosion and saw nothing. Part of his duties was to check temperatures in the various Houses, but he did not check them as usual that day or Monday or Tuesday, owing to pressure of other work. He checked them on Wednesday and they were satisfactory - none below 10°. He had not seen any frozen N/G. in paste, but had seen it sometimes in the pots in Mixing Houses. On such occasions the Chemists take it away. He had not found lumps in Paste, which was always soft, in his experience.

18th Witness - Mr. Cordell - Foreman - Cordite Section.

Mr. Cordell said he had been at the Royal Gunpowder Factory 46 years, mostly in the Cordite Section. He had never seen frozen paste here - only at Gretna - where he worked during the last war for a time. He confirmed Mr. Lewis' statements with regard to usual practice in Cordite Section of drawing Paste from No.5 Store, and said it was usually there in the warm for 12 hours at least. They always used their batches in their proper order and it was only in the very unusual event of the Store being empty that they put Paste on trucks straight from the boat. The maximum time which a boat might be held up there, he considered to be an hour, but he said a truckman could not possibly be held up at an Incorporating House for an hour.

He said he would have liked more experienced men than he had, but that they were doing their best to train them. Rules were read to them regularly and so on.

19th Witness - Mr. Knapman - Superintendent, R.G.P.F.

Mr. Knapman was requested to give evidence in this case principally on the question of frozen N/G. and most of the questions asked were for the purpose of obtaining some more definite information on this matter.

Mr. Knapman stated that he had been 27 years at the Royal Gunpowder Factory, his time being devoted chiefly to Cordite, although he had also spent some years in the Guncotton Section and intermittently in the N/G. Section.

Asked whether he considered a possible explanation of the accident to be the freezing of N/G. he replied that he thought it was quite a possibility. In the last war he said he had known of frozen paste - he rather thought it occurred sometimes in the boats and he had even known it in the Paste Stores, which although heated were fitted with a steam pipe high up in the building (about 7 or 8 feet high) which meant that the floor might still remain cold in severe weather.

Mr. Knapman said he had seen frozen Paste but the bag was not frozen solid - merely the bottom of it, which would have a solid feel instead of being soft as usual, and this solid part at the bottom would break up into chunks as big as the fist if contents were tipped out. In such cases the bag would be sent back to be thawed out before being used.

Mr. Knapman had not seen frozen poured-on Paste when in an unmixed state.

Asked with regard to the lack of experienced staff in the factory, he admitted that generally speaking the staff were not so experienced as the staff during the last war, but there were some who were very experienced. It was merely that at the beginning of the last war the factory had a bigger percentage of experienced men. Men capable of instructing others had to be provided for other factories, and knowing this, the President asked Mr. Knapman whether he considered that his staff was being "bled white", and beyond the danger point. The Superintendent was guarded in his reply, but it appeared obvious that the matter was in fact causing him some anxiety.

APPENDIX VIII.

NITROGLYCERINE SECTION

MIXING HOUSES NOS. 4 & 5

SPECIAL RULES.

1.

The maximum and minimum temperatures of the house during the night are to be noted before commencing work, and work must not be commenced if the thermometer has registered below 10°C. since the previous reading, until the Chemist-in-Charge has been informed and he has made the necessary arrangements. Work is to stop at once if the thermometer falls below 10°C.

2.

Men working in the house are to wear "clean" socks.

"Clean" socks are not to be worn outside the clean barrier.

3.

Neither empty nor filled bags are to be placed between the heating apparatus and the line on the floor.

4.

Filled bags are not to be laid on their sides, except in cold weather. They are not under any circumstances to be placed on the top of one another.

5.

Should any Nitroglycerine become frozen, the fact is to be reported at once to the Chemist-in-Charge, and no attempt is to be made to thaw it until he has made the necessary arrangements.

6.

The floor of the approach is to be kept wet while the house is at work, and the house is to be thoroughly washed down once a month.

7.

Not more than one bag of paste is to be carried at a time.

APPENDIX IX.

I.D.B.

The N.G. charges and G/C. batches (and their raw materials) that were in G/C. Stoves Nos. 14, 18, 19 and 20 and in Mixing House No,5 were all examined in the laboratory according to the normal methods of testing; the results have been satisfactory in every case.

(Signed) R. H. McLINTIC.
C.N/G.

(Signed) W. S. KENTISH.
C.R.

24/1/40.

APPENDIX X.

AIR MINISTRY METEOROLOGICAL OFFICE, LONDON.

52/39.

Kew Observatory,
Richmond, Surrey.

Your Ref. Govt. Accdt. 1940.

February 2nd, 1940.

H.M. Inspector of Explosives,
Cleland House,
Page Street, S.W.1.

Dear Sir,

Your letter of 30th January to the Director of the Meteorological Office has been forwarded to us, and I have examined our records for traces of the explosion on 18th January.

A short period of seismograph of an experimental type, arranged to record the vertical component of ground motion showed a sharp pulse at 10h. 42m. 36s. G.M.T. This was followed by a train of vibrations with a period too short to be measurable and an amplitude decreasing to zero in 10 seconds. The decrease in amplitude is not quite regular and an irregularity at about 5 sec. after the commencement of the pulse may indicate a second shock.

Unfortunately we cannot give an estimate of the actual magnitude of ground movement as the instrument is not designed for that purpose. The time scale of the instrument is 15 mm. per minute, and the timing can be relied on to 1 second.

The disturbance was also just detected by a Wood-Anderson type seismograph, period 3 seconds arranged to record the E-W component of ground motion (The movements are very small and would not have been noticed without the aid of the vertical component record). A similar instrument recording the N-S component showed no disturbance.

The air wave from the explosion was not detected by the micro-barograph here.

Yours faithfully,

G.C. SIMPSON,

Superintendent.

APPENDIX XI

D.O.F.

In connection with the recent explosion in the Royal Gunpowder Factory it should be recorded that all in the vicinity of the disaster behaved with exceptional good order and promptness. There was no sign of panic on account of the possibility of further explosions, and in two danger buildings, each containing sufficient nitroglycerine to cause a new detonation of major effect, process operatives remained in attendance to ensure safety, even after the explosions had damaged their buildings.

SYLVESTER, W.G. 322161, remained inside No. 2 Washing House

(Hillman)

maintaining watch over more than a ton of nitroglycerine in the final purification process.

O'HAGEN, L. 322074, remained inside the nitrating house

(Hillman)

during the stage at which nitroglycerine is particularly sensitive to shock, and completed the process.

SEWELL, S.W. 322084, remained with O'Hagen in the nitrating

(Hillman Trainee)

house and assisted in the operation of the plant.

These three men are deserving of the greatest possible commendation for devotion to duty, and the prevention of a further accident, regardless of personal safety.

P.G. KNAPIAN

Suporintendent,

Royal Gunpowder Factory.

21.1.40.

SYLVESTER, WILLIAM, GEORGE

Address:- 31, Hallside Road,
Forty Hill,
Enfield.

Age:- 25-1/12 years (6.12.14)

Entered Factory- 27.1.37 Process Worker, Cordite Section.
3.8.37 Stove Setter, N/G Section.
6.12.37 Acid Worker, N/G Section
18. 9.39 G/C Stove Chargeman (Tempy.)
N/G Section
30. 9.39 Hillman, N/G Section.

O'HAGEN, LEO FRANCIS.

Address:- 6, Lombard Avenue,
Enfield.

Age:- 25-8/12 years (26.4.14)

Entered Factory:- 15.6.36 Process Worker, G/C Section
16.11.36 Acid Worker, N/G Section.
31.8.37 Pourer, N/G Section.
26.9.38, Hillman, N/G Section.

SEWELL, STANLEY, WILLIAM

Address:- 32, Beaconsfield Road,
Enfield.

Age:- 33-1/12 years (16.12.06)

Entered Factory- 15.4.36 Process Worker, Cordite Section.
13.10.36 Blender & Packer, Cordite
Section.
25.1.37 Stove Setter, N/G Section.
15.3.37 Acid Worker, N/G Section.
31.1.39 Pourer, N/G Section.

APPENDIX XII

The Court of Inquiry endorse the recommendations submitted by the Superintendent, R.G.P.F. in his memo. dated 21/1/40 on the devotion to duty and extreme gallantry displayed, with total disregard for their own personal safety, by

SYLVESTER, W.G.	322161
O'HAGEN, L.	322074
SEWELL, S.W.	322084

The Court are of opinion that the action of these men almost certainly saved a further serious explosion which would have caused additional loss of life, considerable damage to property, and further delay in the resumption of production in the factory.

President: J.C.PELLEREAU.

Lt. Col.

Members. H.A.Phillips, A.D.O.F.

R.P.Evans,
Superintendent,
R.O.F.Irvine.

J.S.Mellor,
Chief Constable, W.D.

A.S.T.Godfrey,
Capt. R.E.

T. Barratt } Research
E. Garratt } Dept.
Woolwich.

22.1.40.

LAB

1

S. R. G. P. F.

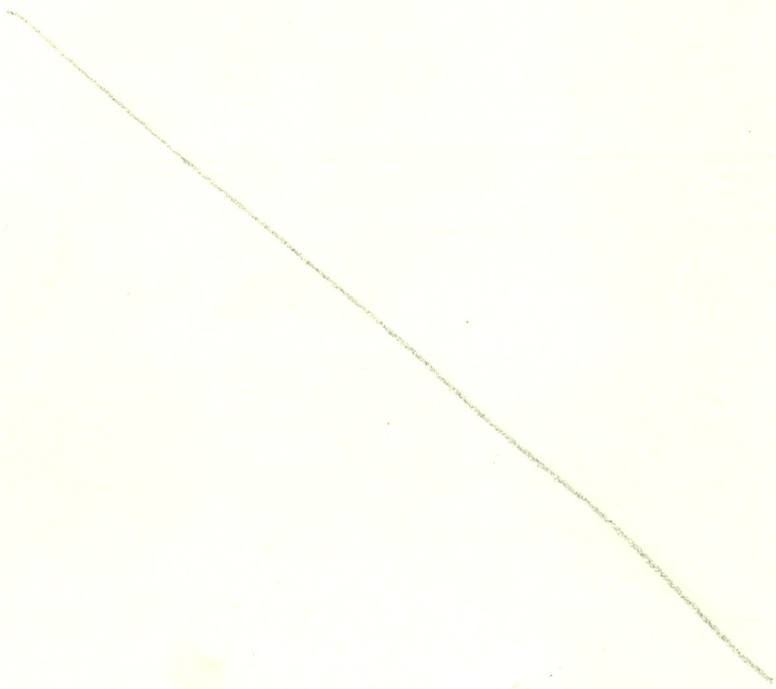
Herewith copy of the Proceedings of the Court of Enquiry into the explosion at R.G.P.F. on the 18th January.

Will you please take steps to implement recommendations at 6 (a) (b) and (c) and 7 (a), and report in due course.

H. A. Phillips,

A. D. O. F. (X).

4.3.40.



copy for I.D.B.

2

D.D.O.F.(X),

The following action has been taken in connection with the recommendations of the Court of Inquiry:

6. a. Instructions have been issued that a boat carrying poured-on material shall not make intermediate calls but must proceed direct from the Pouring-on house to the Mixing House.

To comply with these conditions as regards mixed paste certain facilities must be provided.

- (1) A Railway line from Fishers Green to the Island Stoves along the eastern boundary.
- (2) Provide a canal from No.4 Mixing House to No.6 Mixing House.

The cost of these is as follows:

- (1) £950 (approval already received).
- (2) £2,000 (approval asked for).

6. b. A properly screened maximum and minimum thermometer is being installed in the N/G Section near the office. Arrangements for regular recording by an Asst. Foreman every four hours, and notification of all concerned have been made. Should the temperature fall to 0°C. the chemist on duty is to be informed immediately.

In addition, the existing method of reading and recording temperatures in all N/G buildings is being reviewed. One of the Hillmen is being detailed to read and record the maximum and minimum temperatures of all N/G buildings.

6. c. The special rules have been examined and it is considered that they are quite explicit. The recommendation of the Court that the nature of frozen N/G and paste should be fully explained is being investigated and, after the form this should take has been drawn up, it will be read each week, together with the special rules.

7. a. This matter is now being investigated.

P. G. KNAPMAN

Superintendent,
Royal Gunpowder Factory.

2.4.40.

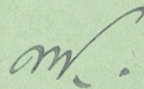
Departmental Memo No.

Minutes to be numbered consecutively.

Sheet No.

I.D.B.

Please see copy of my minute to M.C.



Superintendent,
7/3/40.

To be left blank

Departmental Memo No.

Minutes to be numbered consecutively.

Sheet No.

M.C.

The following recommendations of the Court of Inquiry, held in connection with the recent explosion, have been put forward. I would like to discuss these with you and ¹⁰⁸⁰ Chemist N.G. on Friday at 3.30 p.m.

If possible I would like any that can be implemented to be done before we restart next week.

Recommendations.

- (a) Transport. Measures should be introduced to ensure the quick boat transit of Nitroglycerine poured on Guncotton and Paste at all times, and with this object no boat should be allowed to make intermediate calls on its journey.
- (b) Air Temperature. That should the outside temperature fall below freezing point it should be made the duty of selected responsible officials to warn all operatives to be on their guard against possible freezing of nitroglycerine.
- (c) Special Rules. The Court consider that the Special Rules should be examined to ensure that their intention is clear and that they are understandable by the operatives; thus a short explanation of the nature of frozen Nitroglycerine or Paste would assist the operative in identifying it and in taking the action laid down in the Rules.

Observations.

- (a) The Court consider that steps should be taken to investigate the difference in temperature between the wall thermometer and the ground level of the house and porch to ascertain whether there is the possibility of the latter two falling to a dangerous degree while the wall thermometer is still registering the specified temperature.

Superintendent,
7/3/40.

To be left blank

Departmental Memo No.

Minutes to be numbered consecutively.

Sheet No.

Conference held to discuss the recommendations
of the Court of Inquiry - 3.30 p.m. 8/3/40.

Present:- Superintendent,
I.D.B.
M.C.
Chemist, N/G.

(a) Transport. Quick boat transit can be facilitated by:-

(1) Provision of railway along the Eastern Boundary between the Wet Guncotton Store and the Island Stoves so that Paste Boats are not obstructed by the Wet Guncotton Boat.

(2) By connecting the high level canals between No.4 Mixing House and No.6 Mixing House Buildings 76 - 88.A.

It would be ~~im~~practicable to forbid intermediate calls as this would impede loading of Paste Stores; however, the ~~recommendation~~ of the Court suggests that it would be advisable to rule that Paste from the N/G. Section is to be unloaded into Stores and not on to the trucks which convey it to Incorporating House.

(b) Air Temperature. The N/G. Section is to be provided with a properly housed thermometer similar to the one outside the Main Laboratory, and an arrangement for recording temperatures and notifying all concerned is to be made. In addition the existing method of reading and recording temperatures in all N/G. Buildings is to be reviewed.(c) Special Rules. It was decided to put into effect this recommendation and extend examination of Special Rules to all Buildings in which N/G. might freeze. The advisability of raising the 10°C., minimum to 13° or about, was discussed.

The Court observation concerning difference in temperature between the wall thermometer and the floor was ~~handed~~ for investigation.

held

M.C.
11/3/40.

To be left blank

*with unmined paste,
but not with mined paste*

