

(1) Number of pages 40(2) Date of repair 21.11.38.(3) Initials of the Referencer CF**MADRAS RECORD OFFICE.****Government of Madras.***Public Works* **DEPARTMENT.***Com. 20.6.1860*

G.O. No.

*790*Press
Mis.*129-20*

Dated

*17-4-**1860.***Not to be folded or roughly handled**

*Proceedings of the Madras Government, Public Works Department,
for the month of April 1860.*

No. 129. Read the following Proceedings of the Madras Government in the Military Department, dated 23rd March 1860, No. 1,163:—

Observing that on a Site being selected by the Commander-in-Chief the Chief Engineer will be called on for Plans and Estimates for all buildings required for the Gun Powder Manufactory, and sanctioning the Estimate for the building to set up the Nasmyth Hammer, for immediate execution in anticipation of its being passed by the Government of India. (Vide Military Proceedings from 21st to 31st March 1860, Nos. 118 @ 120A.)

No. 130. ORDER THEREON, 17th April 1860, No. 790.

Ordered to be communicated to the Chief Engineer for information and guidance with reference to paragraph 6.

(Signed C. G. MASTER,
Dy. Secretary to Government.

3

MILITARY DEPARTMENT

PROCEEDINGS OF THE MADRAS GOVERNMENT.

Read the following papers :—

From the Adjutant General of the Army, Fort Saint George, 28th January 1860, No. 108 ; to the Secretary to Government, Military Department.

With reference to the Proceedings of Government dated 26th August last, No. 3021, I have the honor, by order of the Commander-in-Chief, to forward for submission to the Honorable the Governor in Council, the accompanying Proceedings of a Committee assembled at the Mount on the 2nd November 1859, to report on the quality of the Gun Powder manufactured in this Presidency.

2. The report on the Gun Carriages will be forwarded hereafter, the Committee not having yet obtained all the information necessary, to enable them to frame a complete and satisfactory report upon so important a matter.

3. With reference to the report now submitted, the Commander-in-Chief instructs me to say, that he agrees with the Committee that, if the necessary appliances are provided, there is no reason to apprehend that thoroughly efficient Gun Powder cannot be manufactured at Madras. As regards the present site of the Manufactory, His Excellency must observe that though the Steam drying process may, and probably will correct the effects produced by the humidity of the air, that the position of the Manufactory, on the Esplanade of Black Town, is of itself a fatal objection to its being retained on that ground.

(Vide Report No. 1 attached.)

From the Adjutant General of the Army, Fort Saint George, 5th March 1860, No. 216 ; to the Secretary to Government, Military Department.

In continuation of letter from this Department of Forwarding report upon the quality of the 28th January last, No. 108, I have the honor by the Gun powder manufactured in order of the Commander-in-Chief to forward for submission to the Honorable the Governor in Council the accompanying Proceedings of a Committee assembled at Saint Thomas' Mount on the 2nd November 1859, to report upon the strength of the Gun Carriages manufactured at Madras.

2. The Commander-in-Chief has attentively considered this very clear and concise report and quite agreeing in the opinion recorded by the Committee, His Excellency very strongly recommends that it may be acted upon as soon as possible in every particular. The subject is most important; and so is assimilation in Artillery matters throughout India; and His Excellency suggests that the above report be forwarded to the Supreme Government in view to that great object (assimilation in essentials) being given effect to.

3. His Excellency has instructed me to draw the particular attention of Government to the valuable and obliging assistance given to the Committee by Mr. Wright Locomotive Superintendent of the Madras Railway.

4. Sir P. Grant has already expressed his concurrence in the Committee's Report on the Gun Powder manufactured in this Presidency. His Excellency has now only to add that the position of the Manufactory, on the Esplanade of Black Town and far removed from all protection, is in itself a sufficient argument for removing it to the Mount as he has repeatedly suggested and as has now been sanctioned by the Secretary of State.

(Vide Report No. 2 attached.)

ORDER, No. 1163, 23rd March 1860.

The Governor in Council has perused with much interest and satisfaction, the complete and valuable reports, (submitted with the foregoing letters,) by the Committee appointed to investigate the quality of the Gun Powder, and the strength of the Gun Carriages manufactured at Madras.

2. His Honor considers the thanks of Government due to the Officers composing the Committee for the able manner in which the inquiry into these important questions has been conducted; also to the Gentlemen mentioned in the margin, for their valuable assistance to the Committee.

3. The Governor in Council entirely concurs with His Excellency the Commander-in-Chief in the opinion that has been recorded by the Committee in regard to the powder manufactured at Madras, and approves of the suggestion contained in the concluding para. of their report, which will be recommended for the consideration of the Right Honorable the Secretary of State for India, to whom these papers will be transmitted with reference to the Despatch marginally noted.

No. 177, 1st December 1859.

4. On the subject of the removal of the Gun Powder Manufactory from its present objectionable position, as sanctioned in the same despatch, the Governor in Council observes, that on a site being selected by the Commander-in-Chief, the Chief Engineer will be called upon through

the Department of Public Works, to place himself in communication with the Inspector General of Ordnance, and submit Plans and Estimates for all buildings required for the Manufactory, including those for the new machinery and apparatus referred to in the despatch above quoted.

5. Adverting to the report on the Gun Carriages, the Governor in Council considers it satisfactorily proved that a modification of the differences observable in the proportions and construction between the established pattern (Madras) and Royal pattern Carriages in view to assimilate them, to the extent recommended by the Committee will be highly advantageous, and should be adopted. His Honor further resolves to urge on the Supreme Government the important suggestion on this point by His Excellency the Commander-in-Chief, "that assimilation in essentials may be given effect to."

6. Orders were passed for entering in the budget of 1860-61, the estimate for the building to set up the Nasmyth Hammer* taking however into consideration the importance attached to its immediate use by the Committee, the Governor in Council resolves to sanction this Estimate for immediate execution in anticipation of this item being passed by the Government of India.

* Proceedings of Govt. No. 4351, 9th Decr. 1859.

Rupees (5,920-0-0) five thousand nine hundred and twenty.

7. The recommendation of the Committee as to the mode of testing the timber in future, will be carried out under the orders of the Superintendent of the Gun Carriage Manufactory agreeably to para. 2 of Minutes Consultation No. 1226, dated 20th May 1856.

8. The careful selection of the best wood procurable should meet special attention, and the necessary arrangements should be at once effected for obtaining sufficient supplies of "Saul" pronounced by the Committee "undoubtedly the best wood for the most important parts of Carriages."

9. The foregoing papers will be forwarded to the Government of India and to the Home Government as early as practicable.

To the Offg. Secy. to the Govt. of India, Mily. Dept. | Here enter 23rd March 1860, No. 1156;

(True Extract)

W. D'Arachy
Ag. Dy. Secretary to Government.

To the Adjutant General.

„ Inspector General of Ordnance.

„ Department Public Works. *With 4 copies*

„ Quarter Master General.

„ Military Auditor General.

„ Accountant General.

Exd. W. D'Arachy.

Proceedings of a Committee assembled at Saint Thomas' Mount, Madras, on Wednesday the 2nd November 1859 by order of His Excellency Lieutenant General Sir Patrick Grant, K. C. B. Commander-in-Chief in the Madras Presidency.

PRESIDENT.

Brigadier P. HAMOND, Commandant Madras Artillery.

MEMBERS.

Lieut. Col. J. M. ADYE, c. n., Commanding Royal Artillery, Madras Presidency.

„ E. BRICE, Madras Horse Artillery.

Captain T. H. CAMPBELL, Madras Artillery.

„ J. DESBOROUGH, Royal Artillery.

The Committee having assembled pursuant to order, President and Members all present, (with the exception of Lieut. Colonel Adye absent from illness) the General order of His Excellency the Commander-in-Chief, dated 21st September, assembling the Committee is read, as also the letter of the Adjutant General of the Army, No. 5652, dated 23rd September 1859, addressed to the President, directing the Committee to investigate and forward a full report upon the quality of the Gunpowder, and the strength of the Gun Carriages manufactured at Madras.

The above documents are attached to the proceedings: (A.)

The Committee having assembled for the first time upon the 2nd November, to commence their proceedings, then adjourned for the purpose of collecting information, official reports, and other data connected with the two subjects ordered for investigation, re-assembling from time to time as ordered by the President (Lieut. Colonel Adye, joining the Committee on 21st November.)

The first subject to which the Committee directed their attention, was the quality of the Gunpowder manufactured at Madras.

In order to arrive at a clear and distinct conclusion upon the matter, the Committee investigated as fully as possible the four following points:—

1. The proportions of the ingredients used in the manufacture.

2. The purity or otherwise of the ingredients.

3. The method of manufacture.

4. The results as shewn by practical experience, official proofs, tables of ranges, and the reports of various officers as to the general quality of the Madras Powder, &c.

The Committee will attach to their proceedings all official papers they may receive, or such extracts of them as in their opinion will throw any light upon the subject under investigation.

Proportions of the Ingredients.—With regard to the proportions of the ingredients used, the Committee find that they slightly differ from those of other manufactories. The exact quantities of each are shewn in the following extract of a letter from Lieut. Colonel Rowlandson, Madras Artillery, Superintendent of the Powder Manufactory, dated 31st August 1858, addressed to the Inspector General of Ordnance and Magazines.

Proportion of Ingredients.—"These differ in the Madras Powder, from those adopted in all

English.	Madras.
Nitro 75	75
Sulphur 10	11½
Charcoal 15	13½
100	100

"the other factories. The Madras proportions accord more nearly with the theoretical chemical proportions, considered essential to the due strength and properties of Gunpowder; but practically, the proportions used in all the other factories have the recommendation of at least producing better results, and a recent trial of a series of experiments, extending to 15 distinct mill charges composed of the English proportions, gave ranges generally superior to our own; and my own opinion strongly favors the adoption of the same proportions as elsewhere, as per margin, in which opinion I believe Major Simpson likewise concurs."

Lieutenant Colonel Rowlandson's letter from which the above is taken is appended (B.) as also one from Lieutenant Colonel Simpson, Madras Artillery, on the same subject. (C.)

Purity of the Ingredients—Sulphur.—As to the purity of the ingredients employed. By information received from Lieutenant Colonel Rowlandson, it appears that the Sulphur used in making Madras powder is purified by being twice carefully fused, that it has often been chemically tested,

and that there is every reason to believe that it is as pure as any sulphur used elsewhere for the manufacture of Gunpowder.

Sulphure.—With regard to Sulphure. By information obtained from Lieutenant Colonel Rowlandson, it appears that it is found in this country, is bought in its crude state by contract in the market, and is then refined in the Madras powder works.

The process of refining is the same as that used at Waltham Abbey, and the same result is obtained of a perfectly pure article, which is proved daily at the Madras powder works by the most delicate chemical tests.

Charcoal.—Full information upon this important element of Gunpowder was also obtained from Lieutenant Colonel Rowlandson. The charcoal used in the manufacture of Madras Gunpowder is prepared from the wood of the dholl stalk. This wood is light, and of much the same character as that used at Waltham Abbey. Lieut. Colonel Rowlandson considers it admirably adapted for the purpose; and in a memoir on Gunpowder written in 1829, by Mr. Braddock, (who was long connected with the Madras powder works) it is favorably reported upon.

The charcoal when made is furnished by a Contractor.

It is pit-burned by natives near the places where the wood is grown. Owing to its being pit-burned, which is a rude process, a perfectly pure article is not obtained, and this is one great defect, and in fact almost the only one in the materials used in the manufacture of Madras powder.

Lieut. Colonel Rowlandson in his letter to the Inspector General of Ordnance already alluded to, gives the following opinion.

“Charcoal.”—“This important ingredient on which the excellence of Gunpowder so materially depends, is here very different from that used in all the other mills; its being pit-charred, instead of in cylinders, is the primary cause of the deteriorating effect which our powder suffers, but as cylinders have just been imported for this factory, and the dholl stalk from which it is made is excellent, every hope is entertained of the remedy of this deficiency, after the new process is fully brought into use.”

Mr. Braddock in his Memoir also condemns pit-burned charcoal.

Major Baddeley, Royal Artillery, Captain Instructor at Waltham Abbey, in a pamphlet on the manufacture of Gunpowder published in 1857, mentions that pit-charcoal is used for Pyrotechnic purposes, but that cylinder charcoal alone is used at Waltham Abbey in the manufacture of gunpowder.

The fact that the wood when made into charcoal in this Presidency, is also charred with its bark on, is another objection, as increasing the impurities, and is condemned by Lieut. Colonel Rowlandson, and also by all the authorities on the manufacture of gunpowder.

Manufacture.—The third point which engaged the attention of the Committee was the method of manufacture of gunpowder in Madras.

The principal processes gone through in all manufactories before the powder is fit for use are as follows:—

- 1st. Pulverizing the materials.
- 2nd. The mixing.
- 3rd. Incorporation.
- 4th. The pressing process.
- 5th. The glazing process.
- 6th. The drying process.

Pulverizing and Mixing.—With regard to the two first (pulverizing and mixing) it appears that the methods used at the Madras Powder manufactory, although somewhat different from those of other places are efficient and satisfactory, and that there are no defects in these points.

Incorporation.—This is one of the most important processes in the manufacture of Gunpowder, and the differences in the methods pursued at Waltham Abbey and in Madras are (as will be seen by Colonel Balfour's remarks below) very striking.

Mr. Braddock in 1829 writes to the effect, that at that time the Madras powder was not sufficiently incorporated, and that the process was inferior to the one pursued at Waltham Abbey, since his time some improvements have been made, but Colonel Balfour, C. B., Madras Artillery, Inspector General of Ordnance and Magazines, in a report to Government upon Madras powder published this year, speaks as follows upon the point:—“The incorporating process here bears only a general resemblance to the same most important process at home; the preliminary mixing is effected by hand rollers in bags for 4½ hours, in which pressure and friction are combined with

“rolling, as regards mill incorporation it appears that Waltham Abbey powder, as compared with Madras has

A speed of revolutions as..... 8 to 3.
A number of revolutions as..... 16 to 1.
Incorporating pressure as..... 12 to 1.
Weight of mill charge as..... 7 to 10.

“and notwithstanding these very great disparities experience has shewn the relative explosive force of English and Madras powder to be no more than 5 to 4.”

Lieut. Colonel Rowlandson in his letter to Colonel Balfour (appended marked B.) gives a full account of the system of incorporation as practised in the Madras powder works, to which the Committee would call attention.

Major Baddeley in his pamphlet already quoted says:—

“Incorporation is by far the most important process in the manufacture of gunpowder; for however carefully the other part of the fabrication is carried on, should there be a failing in this, the powder will be worth nothing.”

All authorities in fact consider complete incorporation a vital point in the manufacture of gunpowder.

Pressing.—It appears that in this process also considerable difference exists in the method carried out in Madras, as compared with that used at Waltham Abbey.

Colonel Balfour in his pamphlet thus speaks of it.

“The pressing process here is effected by means of screw presses, at home by Hydraulic pressure, the former being uncertain in amount and comparatively feeble in effect, the latter manageable certain and powerful.”

Glazing.—On this point both the late and present Superintendent of the Madras Powder Manufactory agree in opinion that Powder made in this Presidency is glazed in a less degree than that made at Waltham Abbey.

Drying.—Regarding the method pursued in this important process, Colonel Balfour in his pamphlet writes as follows:—

“The drying operation is here effected by the exposure of the green powder, placed upon terraces, to the direct influence of the sun, so that of necessity it is at the same time also exposed to the moisture contained in the atmosphere, and consequently except in the land wind months, the Madras powder must exhibit comparatively a large ratio of moisture.”

By Major Baddeley's account it appears that at Waltham Abbey, the powder is dried in a room heated by steam pipes to a heat of 130° Fahrenheit to which the Powder is exposed for 16 hours. From the standing regulations of the Madras Manufactory it appears that the Powder is only dried 4 hours a day for 3 days by exposure to the sun.

General quality of the Powder.—The last point to be investigated by the Committee is the quality of the powder as shewn by its results, and they have therefore enquired into its powers and equability of range, and also as far as possible into its durability, and other qualities which good powder ought to possess.

As to the length of range the following tables obtained from official sources will sufficiently prove that the Madras powder is in this respect inferior to that manufactured in Bengal, and considerably so, to that made in England and in Bombay.

The following tables of comparative ranges are taken from Colonel Balfour's pamphlet.

Average Range of 5 Rounds.

CHARGE.	WALTHAM ABBEY.	BENGAL.	MADRAS.	BOMBAY.
2 oz.	107	Yds. 88	73	106
4 oz.	188	156	114	199
8 oz.	410	344	288	426
<i>Average Range of 3 Rounds.</i>				
CHARGE.	WALTHAM ABBEY POWDER.	MADRAS POWDER.		
2 oz.	101	80		
8 oz.	389	317		
1 lb.	934	809		
2 lbs.	1381	1292		

The following table shewing the result of Triennial proofs of Bengal, Madras and Bombay Powder, made at Saint Thomas' Mount, Madras, with 1lb. and 2oz. charges in the undermentioned years, also shew distinctly the inferiority of Madras powder in range.

	CANNON POWDER.								MUSKET POWDER.							
	1 lb. Charge.				2 oz. Charge.				1 lb. Charge.				2 oz. Charge.			
	1846	1849	1853	1859	1846	1849	1853	1859	1846	1849	1853	1859	1846	1849	1853	1859
Bengal	649	557	530	644	77	65	65	83	828	718	718	849	80	58	74	86
Madras	567	563	530	608	81	70	72	69	813	708	674	740	82	73	69	74
Bombay	659	568	687	710	76	69	76	95	814	773	844	938	82	76	76	100

A certain number of Officers Commanding Infantry Regiments in this Presidency having been called upon for reports upon the quality of the Madras powder, more particularly as to its power of range and to its adaptability for the Enfield Rifle, the reply of Colonel Staveley, C. B., Commanding Her Majesty's 44th Regiment, is appended to the proceedings (marked D.) His letter fully explains the several points in which the powder falls short, more especially in the question of range. In a second letter he states, that the Madras powder ~~fouls~~ the Rifle more than English powder.

Colonel Law, Commanding Her Majesty's 66th Regiment, writes somewhat to the same effect, and the following table is extracted from his letter, being the result of a trial made by him between English and Madras powder.

The shots were fired from a rest, the rifle having in both cases the same elevation and the range being 750 yards.

Target 12 feet square.	Of 10 rounds English ammunition fired, 9 passed over the Target, the other 1 struck six inches from the top of the Target.
	Of 10 rounds Country made ammunition, 9 fell short of the Target, and the other 1 struck eighteen inches from the bottom of the Target.

On other points Colonel Law writes as follows:—

"Several charges of country made ammunition were weighed and found to weigh $2\frac{1}{2}$ drachms, consequently there is in this respect no difference between Country and English made ammunition, but when used the former (country made powder) soils the Rifle more than the English made powder, containing a greater proportion of failing and being moreover more susceptible of damp. The defects complained of may be partly attributable to the country made powder not being so highly glazed as the English powder is, and consequently liable possibly, to a certain degree at least both to contract damp and produce dust."

Equability of range.—As to equability of range a variety of tables have been laid before the Committee, shewing its quality in this respect as compared with the powder of the other Presidencies, none of which tables are very conclusive. A table of triennial proofs is attached (E.) by which it appears that as regards the Cannon powder, that made in Madras is slightly superior in equability to that made in Bombay or Bengal, but as regards the musket powder, Madras is inferior except in the proof made with a 2 oz. charge in which it is again superior.

As to the durability and other qualities, it is difficult to obtain any precise data, or comparative results to judge by, but all authorities upon Gunpowder are of opinion, that powder which is not properly pressed, glazed and dried, is more apt to become deteriorated, and to absorb moisture, than that which is more carefully prepared in these respects.

Lieutenant Colonel Rowlandson in his letter (marked B) says:—

"The introduction of the Waltham Abbey system of glazing, dusting and drying, would materially affect the service properties of our powder, in cleanness, durability and ranges; and in my opinion, is indispensable, together with more thorough incorporation, to the realization of the hope of turning out a powder that can cope with the produce of a manufactory so elaborate and perfect in its establishment, and in all its processes, as the Waltham Abbey Mills.

As to these and other points connected with the manufacture of Madras powder, Lieutenant Colonel Simpson in his letter (appended marked C.) gives a very plain summary of the facts of the

case, and the Committee would beg to call attention to his letter, more especially from the sixth paragraph to the conclusion.

Colonel Balfour, the Inspector General, is equally clear and decided in his views, he writes:—

"Although the Madras made powder now occupies a somewhat lower place than the powder of Waltham Abbey, Ishapore and Bombay, it still possesses the characteristics of a good service powder, that is, it gives a good range, is of equable and uniform strength, keeps well and travels well; and produced as it is by the most simple, primitive unscientific manual labour, with only pit-charcoal, and dependent on the winds and sun in a coast climate, for winnowing and drying, it is surprising it should so well maintain the character of a strong powder of equal action.

Again he says:—

"The future improvement of Madras powder will be found in the better means now available for carrying on the several processes of manufacture, and in the interest which has been awakened on the subject and the consequent investigation it is receiving. * * * If with the rude appliances hitherto used, such a serviceable article as the Madras powder has been produced, it may reasonably be inferred, that in proportion to the degree by which the improved means excel those hitherto adopted, will the character and quality of our future be superior to the present Madras powder."

The Committee have obtained from Lieutenant Mitchell, 1st Native Veteran Battalion, a report upon the general appearance of Madras powder when examined with the aid of a microscope. His report after explaining his method of examination, which seems satisfactory, states as follows:—

"The Indian powders have a rough surface somewhat like coke, and the light reflected from the numerous asperities gave it a glistening appearance. The grains were of every imaginable form, the Bombay being sharp and angular, the Bengal somewhat rounded at the angles, and the Madras still more so."

"The Waltham Abbey powders have a larger grain and are highly polished, particularly the F. G.* which has the lustre of polished black lead; there are moreover no sharp points or asperities, the whole being perfectly smooth, and all the angles very much rounded off. The colour externally is uniform.

"In the Indian powders the prevailing colour may be described as pepper and salt, but the surface is studded with specks of sulphur which are of considerable size compared with the size of the grains of powder; this is most remarkable in the Bombay powder, less so in the Bengal, and least of all in the Madras. In the Bombay and Bengal powders specks of charcoal of considerable size were also visible.

"2ndly. From the highly polished surface of the Waltham Abbey powder, it was impossible to see its structure until the grains were broken; some of the largest grains of the *L. G. were therefore broken in two, and the fractured surface thus obtained was compared with grains of the Indian powders similarly treated."

"The difference in structure was visible at a glance, the grain of the English being much finer than that of the Indian powders, the colour was more uniform, and like the fracture of a freshly broken state. It was not however perfectly homogeneous, but the specks of sulphur and charcoal were smaller and much fewer than in the Indian powders."

By another experiment Mr. Mitchell says, he ascertained as regards Madras powder:—

"That the larger pieces of sulphur were not merely aggregations of finer particles as I at first imagined they might be, but pieces that had escaped the reducing power of the incorporating mill, and forcibly point out the necessity of a longer exposure to its action."

Mr. Mitchell in conclusion gives the following opinion:—

"The opinion I have formed, after carefully examining the powders submitted to me is, that taking the Waltham Abbey, the acknowledged best Military powder as a standard, the whole of the Indian made powders are insufficiently incorporated; that the Bombay powder is in this respect the worst, and the Madras the best, and that the Bengal is somewhere between the two former, but occupies a place nearer to the Madras, than to the Bombay."

Opinion.—The Committee having now as far as possible enquired into the proportions and purity of the materials used in the manufacture of Madras powder, having also investigated the

method of manufacture as detailed in their proceedings, and having also attentively considered the results as shewn in the tables of ranges, in the opinions of officers, and in other official data, now proceed to report upon the quality of the Gupowder and to offer certain suggestions on the points which have come before them.

1st. As to the proportions of the ingredients used, it will be perceived that these differ to a small degree from those of other manufactories. As far as can be ascertained it seems that this difference originated in an idea that the proportions used were better adapted to the mode of manufacture in Madras, but as no favourable result appears to have followed, the Committee recommend that the ordinary proportions be adopted, viz.:

Sulphur.....parts	10
Saltpetre....."	75
Charcoal... .."	15
	100

2nd. With respect to the purity of the ingredients, it is apparent that the most important of them, Charcoal, has always been prepared in the most rude way, having been charred in pits by natives, and not having even been previously stripped of its bark; the result has been an impure article which is condemned by all authorities on the subject. As cylinders however for burning charcoal have arrived in this country, the Committee are not called upon to make any further remark on this point.

3rd. With respect to the manufacture of Madras powder the evidence quoted in these proceedings shews clearly that some of the most important processes have been hitherto very insufficiently performed, more especially those of incorporating and drying.

The Committee however beg to report that the following articles of machinery for making powder in Madras, have either arrived or have been ordered by the Government.

1. Cylinder for burning charcoal.
2. Hydraulic Press with pumps and appurtenances, &c.
3. Breaking down Rolls.
4. Granulating Machinery.
5. Dusting reel and separator.
6. Spare sieve for frames and sundries.
7. Application has also been made to Government for fittings for a steam drying room.

The defects therefore, which have hitherto existed in the quality of Madras gunpowder will thus in a great measure be remedied; but the Committee beg to observe that the Incorporating Mills are worked by Bullock draught instead of by steam, and that no provision has been made to remedy the defect. Although the number of revolutions required for incorporation can be obtained with the present system, still the proper speed of revolutions which is important, never can, and the Committee therefore strongly recommend the adoption of steam power.

When this is accomplished, they see no reason why powder made in Madras should not attain the highest standard, and be equal in every respect to that manufactured at Waltham Abbey or elsewhere; and although some objections have been made to the site of the Madras powder works, as being damp and too close to the sea, they are of opinion that when the powder is dried artificially by steam in a room, instead of being merely exposed to the sun, as at present, these objections will in a great measure disappear.

The Committee consider it necessary to remark that although Madras powder has maintained for some years past a somewhat lower position than that manufactured in the other Presidencies; still it has as far as length of range is concerned always exceeded the standard laid down by the Government; and as to equability it is equal to that made in Bombay and Bengal. It has therefore fulfilled the conditions hitherto required of it. But in the present day when both small arms and Ordnance are improving so rapidly in their construction, and when accuracy of range and precision are so essential to give due effect to their power, it seems to the Committee that one common standard for powder must be established, and that the system hitherto pursued of independent action in the three Presidencies of India, ought to cease.

It appears that Waltham Abbey powder is of a better quality and altogether more carefully made than any other. The tables of ranges also of the Enfield rifles and of the Royal Artillery guns are all regulated by it; and the Committee therefore strongly recommend that the mode of manufacture as carried on at Waltham Abbey shall be adopted in every respect, and that Waltham Abbey powder be considered the standard.

P. HAMOND, BRIGADIER.

JOHN ADYE, LIEUT. COLONEL,
Comdg. Royal Arty., Madras Presidency.

EDWARD BRICE, LIEUT. COLONEL,
Madras Horse Artillery.

T. HAY CAMPBELL, CAPTAIN,
Madras Artillery.

J. DESBOROUGH, CAPTAIN,
Royal Artillery.

A.

GENERAL ORDERS BY HIS EXCELLENCY THE COMMANDER-IN-CHIEF.

Head Quarters: Choultry Plain, 21st September 1859.

With the sanction of Government a Committee composed as follows will assemble at such time and place as the President may appoint for the purpose of reporting on a subject that will be submitted to it by the Adjutant General of the Army.

PRESIDENT.

BRIGADIER P. HAMOND, Commandant of Artillery.

MEMBERS.

LIEUT. COLONEL J. M. ADYE, C.B., Commanding Royal Artillery.

" E. BRICE, ... Horse Brigade.

CAPTAIN { T. H. CAMPBELL, Madras Artillery, Commissary of Ordnance, Bangalore.

" J. DESBOROUGH, Royal Artillery.

The proceedings to be forwarded to the Adjutant General of the Army.

A.

No. 5652.

To BRIGADIER P. HAMOND,

Commandant of Artillery.

SIR,—With reference to G. O. C. C. of the 21st instant, I have the honor by order of the Commander-in-Chief to request, that the Committee of which you are President, will be good enough to investigate and forward a full report on the two questions referred to in the enclosed proceedings of Government, dated 26th ultimo, No. 3021, viz. the quality of the Gun Powder and the strength of the Gun Carriages manufactured at Madras.

I have the honor to be, &c.,

(Signed) W. G. WOODS, LIEUT. COLONEL,

Adjutant General of the Army.

ADJUTANT GENERAL'S OFFICE,
FORT SAINT GEORGE,
23rd September 1859.

B.

No. 179.

GUN POWDER MANUFACTORY,
MADRAS, 31st August, 1858.

From MAJOR G. ROWLANDSON,

Acting Supt. Gun Powder Manufactory.

To THE INSPECTOR GENERAL,

*of Ordnance and Magazines,**Fort Saint George.*

SIR,—1. In accordance with your letter, No. 3394, of 27th ultimo, I have the honor to forward a few remarks "on the comparative merits of the Madras powder, as now made, and of the different kinds of powder in use in Bengal and Bombay, and of the English F. G. and L. G. powders in reference to all their properties and qualities.

2. The 2nd para. of your letter, gives me to understand, that you desired this report to be prepared in co-operation with Major Simpson, to whom, I therefore forwarded a copy of your letter, and awaited the communication of his views; but your letter, No. 4464, of the 19th instant, forwarding Major Simpson's replies to the queries contained in your first letter, now apprizes me of your having obtained direct from that Officer the information you desired, and which, I doubt not, it has been more satisfactory to him to place on record under his own immediate signature and responsibility; and, as I observe that in the consideration of the points submitted for his report, the subject generally, as set forth in the preamble of your letter, has been more or less fully discussed in his reply, being intimately and inseparably involved therein, I should have abstained from offering any further remarks of my own, as superfluous, had not your request been repeated in your second letter above quoted.

3. Although the Madras made powder now occupies the lowest place amongst the Waltham Abbey, Ishapore and Bombay powders, its history for more than half a century, as derived from official records, testifies to its intrinsic value, as a production "of a maximum strength (practical effect) with a minimum of labor;" and its comparative superiority not very long ago, caused the Madras factory to be excepted, when machinery from Europe was supplied to the Bengal and Bombay factories, to improve their manufactures; the consequence of which, has been to raise the character of their powders, while the Madras has remained stationary; but it would be a mistake and an injustice to suppose that it has deteriorated, which indeed, the constant results of the various tests, whereby the value of powder is determined, as well as the official record of its proof ranges from month to month, satisfactorily disprove; although it has been surpassed by the others, under the advantages of superior means of production.

4. The characteristics of a good service powder, are that it gives a good range, of equable and uniform strength, keeps well, and travels well.

5. The conditions essential to these results are—1st, purity of ingredients; 2nd, their proper proportions; 3rd, thorough incorporation; 4th, adequate density; 5th, due size and proportion of grains; 6th, cleanness from dust; and 7th, perfect dryness; failure in any one of these conditions impairs the final result; but defect in the 3d and 7th is fatal.

6. The processes by which these conditions are fulfilled in the Madras mills, differ primarily, in that nearly all are performed with the simplest and most primitive means and appliances, by manual and bullock labor, with the least possible expenditure, whereas the Waltham Abbey manufacture is produced by elaborate machinery worked by water power and by steam, under the skill and experience of permanently trained agency, without regard to cost, and at the Ishapore and Bombay factories, the same machinery has been introduced, but not as yet I believe worked by steam.

7. The results have established the character of the Waltham Abbey powder as the standard of excellence to the world; while those of the other Indian factories have been raised to a close approximation to it.

PURITY OF INGREDIENTS.

NITRE.

8. This is, in effect, secured in all the manufactories, though by varying means; the mechanical contrivances and arrangements are better planned at Waltham Abbey. The boilers are filled from the vats by pumps, and pure water laid on to all parts of the refinery, with cocks and pipes at convenient intervals; the mother waters are drawn off from the bottom of crystalizing vessels by means of cocks and pipes, whereby they are conducted at once to the vats or cisterns, in which the next processes are required; thus saving time and labor, leaving the crystals in a purer condition and saving washing waters and their subsequent evaporation. Here, all this is performed by cooly labour, the water and mother waters are carried about in copper vessels, baled out from the crystalizing pans, whereby the crystals are disturbed and broken, and washed continually with the impure mother water, in this process &c., time and labor are wasted; there being no well or pure water nearer, all has to be brought from the "Seven Wells," (1½ miles distant) by water carts, and the expense of this, and distilling 144 gallons for daily use, entail great expense, in the aggregate, all which is saved at Waltham Abbey, and might, to a great extent perhaps, be similarly improved here. The nitre is fuzed at all the other factories which is not done here; but the result at either manufactory is the same, viz., a material of perfect purity with the least perceptible wastage.

SULPHUR.

9. The sulphur is alike twice fuzed and a pure material secured in all the factories; the complication of the economic arrangements at Waltham Abbey, to obtain the secondary products of "Flowers of Sulphur" and "sulphuric acid" are not required here, where these products have no mercantile value and are not used by ourselves.

CHARCOAL.

10. This important ingredient, on which the excellence of Gun-Powder so materially depends, is here very different from that used in all the other mills; its being pit-charred, instead of in cylinders, is the primary cause of the deteriorating effect which our powder suffers; but as cylinders have just been imported for this factory, and the dhol stalk from which it is made is excellent, every hope is entertained of the remedy of this deficiency; after the new process is fully brought into use.

PROPORTION OF INGREDIENTS.

11. These differ in the Madras powder, from those adopted in all other factories. The Madras proportions accord more nearly with the theoretical chemical proportions, considered essential to the due strength and properties of good Gun-Powder; but, practically the proportions used in all the other factories have the recommendation of at least producing better results; and a recent trial of a series of experiments, extending to 15 distinct mill charges, composed of the English proportions, gave ranges generally superior to our own; and my opinion strongly favors the adoption of the same proportions as elsewhere, as per margin, in which opinion, I believe, Major Simpson likewise concurs.

Nitre...	75 as used
Sulphur	10 instead of 11½
Charcoal	15 do. 13½

PULVERIZING AND BOLTING OR SIEVING INGREDIENTS.

12. This is effected in various ways. At Madras the nitre is pulverized under a mill, and bolted through fine wire gauze; the sulphur is pounded in metal mortars and bolted through silk lawn. The charcoal is crushed between two cylinders and bolted through wire gauze. At Waltham Abbey the nitre and sulphur are pulverized under mills, and the charcoal as at Madras; but Mr. Hall's conical grinding machine, as in use at Waltham Abbey, appears a far more effectual instrument for the charcoal. At Ishapore and Bombay all are done by light mills and sieved. Whatever methods be used for pulverizing, the practical effect depends on the fineness of the sieves through which the materials are bolted or sieved; the use of the mill for nitre here, is expensive, and the mill far heavier than needful or useful; but it is of secondary importance; whereas the fineness of the pulverization resulting from the sieving, is essential to thorough incorporation and cannot be carried too far.

MIXING THE INGREDIENTS.

13. This preliminary to the incorporating process, likewise differs in the Madras, from the other factories, being here effected by hand rollers in trays for 4½ hours; in which, pressure and

friction are combined with rolling, whereby the ingredients are not only mixed, but an incipient degree of incorporation is produced. In the other factories the mixing is made in barrels, which are made to revolve at varying degrees of rapidity, and for various periods; the barrels at Waltham Abbey being of metal, with an interior machinery which revolves in the opposite direction to the outer barrel, at 100 revolutions per minute; and 5 minutes suffices for the mixing; at Ishapore and Bombay wooden barrels with large quantities of metal balls, are turned for about two hours, at about 8 revolutions per minute; unless Coffin's mixing barrels (same as at Waltham Abbey) have been introduced, of which I am not aware. Some kind of mixing machines have arrived for us.

INCORPORATING MILLS.

14. These in principle and operation are the same in all, the great difference being in the extent to which it (the incorporation) is carried. At Waltham Abbey a charge of 42 lbs. undergoes a pressure of cylinders, weighing 4½ tons each, 1,600 revolutions in 3½ hours at between 7 and 8 per minute; giving an aggregate of pressure of 14,400 tons. In Madras a charge of 60 lbs. is subjected to 100 revolutions in 35 minutes; the cylinders each weighing something under 6 tons; so making an aggregate of pressure of less than 1,200 tons only. At Waltham Abbey the incorporation is continued until the certain effect is produced, which the trained eye of long experience alone can detect; here the process stops at a fixed point, whatever be the degree of completeness of the effect on the powder; at Waltham Abbey every separate charge is subjected to a check proof, before the composition is carried through the subsequent processes; here a proof is only applied to the out-turn of a whole day's work, i. e. to 1,800 lbs. and so defects in any particular charge (of 60 lbs.) pass undetected at Waltham Abbey a perfect incorporation is the point insisted on, and the degree of incorporation necessary to effect that is left to the unfettered judgment of the manufactory; here the manufactory is tied down to a fixed rule of manufacture, without discretionary power, and to a fixed out-turn of powder daily; and a test applied there to check imperfection, is omitted here, and so left unknown; at Waltham Abbey the motive power is steam, here bullock draft.

15. Thus, as regards mill incorporation, it appears that Waltham Abbey powder, as compared with Madras, has

A speed of revolutions as.....	8 to 3
A number of do. as.....	16 to 1
Incorporating pressure as.....	12 to 1
Weight of mill charge as.....	7 to 10

The Waltham Abbey powder, experience shews to possess an explosive force as compared with Madras powder of 5 to 4; which in no degree accords with the vast disproportion of incorporation given to the two powders as above shewn; and the difference in effect produced in favor of the Madras powder, must be attributed to the amount of incorporation which the Madras powder receives in the mixing trays, before going to the mills; experience has proved that there is a limit to the amount of mill incorporation, beyond which no further advantage accrues; it may not unreasonably be inferred therefore, that the degree of mill incorporation at Waltham Abbey may, possibly, be carried to a useless excess. Nevertheless, it was the deliberate opinion of Mr. Brad-dock, and one which can admit of little question, that our powder is not, and never has been, perfectly incorporated; and as the secret of good powder unquestionably lies in its thorough incorporation, we must look primarily to this defect in our manufacture, for the comparative inferiority of its range to the other powders. To attempt any assimilation with the Waltham Abbey process, would either involve an expense beyond its value, or with present means, reduce the daily out-turn to a degree wholly inadmissible. The mixing machines arrived,* in addition to our present process, promises fair to add considerably to the degree of incorporation now obtained; which with other improvements in the Charcoal, and other processes, will, I trust, be found greatly to raise the standard range of our powder.

16. At Ishapore and Bombay the incorporation is conducted very much alike; after the Triturating mixing barrels, the charge of 80 lbs. is subjected, in the former mills, to 300 revolutions; and in the latter to 240 revolutions; the cylinder runners being about the same weight as at Madras, nearly 6 tons.

* Which bear no resemblance to the barrels in use at Waltham Abbey, and the use of which is not described, so as to be any guide.

17. The gravimetric density of the Madras powder accords very closely with that of the other three manufactories, and quite comes up to what is considered a sufficient density by the best authorities. The Hydraulic press has several recommendations for facility power, and regularity; but from its introduction I look for no marked alteration in the gravimetric density of our powder, which is not desirable.

SIZE AND PROPORTIONS OF GRAINS.

18. There is little difference in the sizes of grain in the various powders under consideration; but the mode in which the grain is produced differs greatly in the Madras, from the other three factories; in all which latter, the cake is converted into grains by machines; that in use at Waltham Abbey, appears a most elaborate and perfect piece of mechanism; combining the operations of corning and sieving, without the presence or assistance of any human being in the room with it. At Madras all this is performed by manual labor: the press cake, from the screw press, is broken up on the floors by hand clubs, instead of by a machine as at Waltham Abbey: the broken up cake is pounded on the floor with mallets, and rolled with rollers, and sieved through hand sieves, on wooden horses; the process is slow, laborious, and produces a large proportion of dust, which involves extra labor, time and expense in the increased after processes, and in re-making; it also necessitates the exposure of gangs of workmen to the constant risk of explosions, in the most dangerous stages of the manufacture.

19. There is considerable difference in the form and appearance of the grains; the English is peculiarly angular and irregular in shape, more like slabs of polished slate, under the microscope; while the Madras looks more like blocks of rough coal; the shape is attributable to the different methods of granulating; and the polish to the high degree of glazing imparted to the English powder; of which Madras powder has a minimum. Whatever may be the value of the theory which ascribes to powder of spherical, even grains, the highest standard of excellence, (*ceteris paribus*), it is certain that the Waltham Abbey by no means answers this description; while it certainly holds the highest place for general service powder; but beyond certain limits, within which all the powders are found, it seems admitted by the best authorities, that little appreciable importance attaches to minute varieties of size and shape of grain; and no defects in our powder are to be ascribed to the grains employed.

CLEANNESS FROM DUST.

20. In this particular the Waltham Abbey powder excels, being beautifully clean: the result of an unsparing attention to the dusting processes by the best mechanical means and without regard to time, all which is simply impracticable in this manufactory, worked by manual labor, and required to produce a maximum daily out-turn from each mill.

21. The dusting at Waltham Abbey is performed in reels, of different kinds for L. G. and F. G. and for before and after glazing and drying. At Madras the powder is winnowed in the wind, and if that wind is a moist wind, as it mostly is on this coast, the powder imbibes the moisture, while it is freed very imperfectly from dust, and so requires redrying, which produces more dust, each process thus neutralizing the other, and in the end leaving a powder imperfectly free from dust, which is a vital defect affecting its Keeping properties, and its explosive force.

GLAZING.

22. The glazing is of great importance to the preservation and travelling qualities of service powder, and affects considerably its rapidity of combustion; like density it is requisite in varying degrees for large and small grain, and for various sizes and natures of weapons, but has a limit, beyond which it ceases to be useful, and becomes injurious. The Madras powder is unquestionably very insufficiently glazed, for which increased means to save time would be necessary, though the introduction of machinery working several reels at once would, as at Waltham Abbey, facilitate the operation in the most effectual and least costly way.

PERFECT DRYNESS.

23. Whatever be the perfection of all other processes in powder making, defect in this, as in incorporation is fatal; the most perfect powder in a dry atmosphere loses immensely its force in a damp, moist atmosphere, an unquestionable fact, too little taken into account in estimating the proof value of powder. This indispensable finish to powder is entirely dependent here on the wind, and weather and sun; at home it is stove dried, or in a room heated by steam pipes, by which the

duration and degree of heat can be regulated at pleasure, and the effect of perfect desiccation ensured by the most satisfactory method at all times. It is true that, as stated in Mr. Braddock's memoir, speaking of this climate "the land winds, coupled with solar heat, cannot fail to render perfect the last important operation in its manufacture;" but the land winds only blow from May to August, and often accompanied with rain and humidity during those months, with a cloudy sky, which prevail from February to May and often into June, are wholly unsuitable for drying, and the North and North East monsoon winds being sea breezes on the coast, are little or no less so; the difficulty and imperfection of our drying process, is consequently a real and serious defect, which the means of artificial drying, for use when the weather necessitates doing so, can alone remedy.

24. With these observations, I would desire in conclusion, to offer a few remarks on the advantages which it appears to me are justly to be anticipated from the machines recently imported, when brought fairly into use. The *cylinder slips* for preparing charcoal will have, I apprehend, the most important beneficial influence on the powder manufactured from them.

25. The *Mixing Machines*, in addition to our present process, will, I entertain sanguine hopes, much improve the important, and heretofore insufficient amount of incorporation.

26. The *Hydraulic Press* is a far superior instrument to the screw heretofore used, and gives us a power of carrying density to any degree required; but its practical influence on the powder, I see no reason to expect, will be very different from what we have.

27. The *Granulating Machine** is a very important acquisition, and will greatly facilitate the manufacture and improve the uniformity of the grain; but no important effect on the proof range is to be anticipated from it.

28. The introduction of the Waltham Abbey system of *glazing, dusting and drying*, would materially affect the service properties of our powder, in cleanness, durability and ranges; and in my opinion, is indispensable, together with more thorough incorporation, to the realization of the hope of turning out a powder that can cope with the produce of a manufactory, so elaborate and perfect in its establishment, and in all its processes, as the Waltham Abbey mills.

29. In connection with the subject of the machinery recently arrived, and for which buildings will have to be erected, it may not be irrelevant to allude here, to the very important consideration of the locality of the present mills, which, I believe I may safely affirm, has not one advantage to recommend it; while its proximity to the sea, total deficiency of pure water, and swampy nature in the rainy seasons, seriously disqualify it for the purposes of a Powder Manufactory. Very great stress is laid at home on the importances and advantages of water power, and the presence of streams of water running through the works, for facilitating the operations, and diminishing the danger incident to the work. The buildings now on the ground, which would be useful for other purposes to the State, will become useless alike to the works, after the new ones are erected, and to any other department, if the manufactory be retained where it now is; whereas, its removal to an eligible site more into the interior, in the vicinity of a river which might be made to afford ample supplies of water, and where the humid effects of the sea breezes would not be experienced, as they are in its present site, would leave at the disposal of Government, for other purposes, the whole of these buildings. The present locality presents also another very strong objection to its suitability, which though not of primary importance to the manufacture, is worthy of due consideration and by no means of minor consequence, inasmuch as it affects permanently the comfort and health of the establishment, and European families, obliged to live and labor in the manufactory, and that is, its being literally surrounded by, disgusting and offensive factories and establishments, of such a nature as are banished in all well ordered communities to a distance from human habitations: such as pottery, bone burning factory, human body burning grounds, slaughter house, and the receptacle for all the filth and offscourings of Black Town, from all of which the most serious and offensive annoyances, are constantly experienced by the employés and inhabitants of the Powder Mills.

I have the honor to be,

Sir,

Your obedient servant.

(Signed) G. ROWLANDSON, Major,

Actg. Superintendent Gunpowder Manufactory.

C.

ORDNANCE DEPARTMENT.

No. 3222.

FROM MAJOR G. W. Y. SIMPSON,

Acting Principal Commissary of Ordnance.

TO THE INSPECTOR GENERAL

of Ordnance and Magazines.

SIR,—I have the honor to acknowledge the receipt of your Memorandum, dated 5th August 1858, forwarding letter No. 3394, of the 27th July last, to the address of the Superintendent Gun Powder Manufactory, and to forward herewith replies to the several queries therein proposed.

1. Explain the sizes of Mesh Sieves, through which the grains of C. P. and M. P. will pass, and will not pass. 1. C. P. is all grain that will pass No. 10 mesh sieve, and will not pass No. 24 mesh sieve.

2. M. P. is all grain that will pass No. 24, and will not pass No. 42.

3. The C. P. should consist of equal proportions of grains, resting on No. 14 mesh, on No. 18 mesh, and on No. 24 mesh; but, in manufacture the real several proportions, of sized grains, only approximate to these given proportions.

4. The M. P. consists of varying proportions of grain, one portion resting on 30 mesh sieve, another on 36 mesh sieve, and a smaller portion on 42 mesh sieve, that is

C. P.			M. P.		
All grain that passes 10 Mesh...	$\frac{1}{3}$		All grain that passes 24...		In varying proportions.
" rests on 14 "	$\frac{1}{3}$		" rests on 30...		
" passes 14 "	$\frac{1}{3}$		" passes 30...		
" rests on 18 "	$\frac{1}{3}$		" rests on 36...		
" passes 18 "	$\frac{1}{3}$		" passes 36...		
" rests on 24 "	$\frac{1}{3}$		" rests on 42...		

5. The Ishapore and Bombay mills, for many years, have followed the Waltham Abbey system of manufacture. On assuming charge of the Madras mills, I strongly urged the adoption of the same system; my proposition was supported, and the machinery for carrying out that system, has since been furnished by the Home Government.

6. The existing Madras system, is wholly different from that followed at Waltham Abbey, but chiefly so in these points:—

Note—Coleman's patent Slip Cylinders, for preparing Charcoal, 1. The charcoal in England is just received for the Madras mills. cylinder burned, here it is pit burned

2. The incorporation process here bears only a general resemblance to the same most important process at home.

Note—An Hydraulic Press since received from England for the Madras mills. 7. The pressing process is different, here it is effected by means of screw press, at home by hydraulic pressure; the former being uncertain in amount, and comparatively feeble in effect; the latter manageable, certain, and powerful.

Note—A Granulating Machine since received for the use of the Madras mills. 8. The granulating process differs in all respects from the Waltham Abbey system; here it is carried out in all stages, by hand labor, in England by means of very perfect machinery.

9. The drying process at Madras is also a different, and a very imperfect method, compared with the same process in operation at Waltham Abbey.

10. The drying operation is here affected by the exposure of the green powder, placed upon terraces, to the direct influence of the sun, so that of necessity, it is at the same time also, exposed to the action of the moisture contained in the atmosphere; and indeed, with the exception of the land-wind months, powder must unavoidably, as dried at Madras, from this cause, exhibit a comparatively large ratio of moisture, inasmuch as the powder cannot be made drier

than the atmosphere in which it is dried. At Waltham Abbey, the drying is effected by artificial means, in closed rooms, and is perfect in result; the defective drying of the Madras powder, during the prevalence of sea breeze, or southerly wind, reduces its proof range, by at least $\frac{1}{4}$ th or $\frac{1}{3}$ th of the range the same powder would exhibit if perfectly dry. Still under all these disadvantages, the Madras powder does give ranges of an equable character, considerably above the standard ranges, established by the Government of India, and with the machinery now arriving from England, still better results may be ensured.

11. Density retards combustion; that is, grains of equal sizes, and differing only in densities, would consume in a direct ratio of their densities, the greatest density in the greatest time, the least density in the least time; but with dense powder, while its inflammability is thus diminished, the quantity of the gases produced (that is, in other words, its propellant force) is increased, because dense powder contains, bulk for bulk, a larger quantity of nitre, charcoal, and sulphur, than less dense powder.

12. Grains of the same density, and differing only in size, will consume in the ratio of the size of the grain, the largest in the longest time, the smallest in the least time.

13. In speaking of relative times of combustion, as dependant on size of grains, we must assume the mode of manufacture, the purity of ingredients, the density of grain, to be identical, as, if any one of these conditions differ, relative times of combustion will also differ.

14. The size of grain is wholly distinct from the density of the grain; density includes, or refers to, the quantity of material included within a given bulk or grain, whatever the size of that bulk or grain may be. The size of grain materially influences the rapidity of combustion; for, in burning two equal quantities of powder, granulated from the same composition, but of different sized grains, the smaller size will be consumed in less time than the larger, not only because it is smaller, but because it presents also a larger comparative surface to the action of the flame, and is more immediately resolved into gases. The form, or shape of the grain, also influences rapidity of combustion: if the grains be of a rounded form, there will be a greater number of interstices in the charge, and so a greater facility given to the transmission of the inflamed gases, generated by the grains first ignited, through the charge. The rounded form has been strongly recommended for the Minie rifle, but if of this form, the powder should be of a full size grain and some density, otherwise the combustion would be too rapid. Grains of an elongated, or flat form, on the contrary, fit into each other, and offer obstruction to the transmission of the inflamed gases through the charge, and therefore, especially in large charges, retard combustion.

15. This is dependant on the purpose for which the powder is manufactured, for general requirements of service, the variety of sizes of grain is both more economical in manufacture, and more advantageous in practice, especially in large charges. For instance—Rifle powder to propel the cylindro conoidal bullet should be, theoretically, of equal, fair sized grain, and of moderate density, because, such grains being of equal size would consume in equal times, and would thus generate the gases in progressive equal volumes, and so would attain full power by equal and gradual successive increments of propellant force, acting equally on the soft leaden bullet, and consequently be less liable to injure the symmetry of its form in forcing it to follow the rifle grooves; whilst with the large charges for guns, the mixed grain is advantageous, because the small grains, burning in shorter times, accelerate the combustion of the large grains by increasing the temperature of the gases, and so ensure in a greater degree the entire combustion of the whole charge, before the shot leaves the gun.

16. The size of grain, the degree of density of grain, and of glaze, are all dependant on the particular purpose for which the powder is intended. The Government powders are manufactured to meet the general requirements of service.

17. In replying to this question, I must repeat the conditions, on which alone questions of this nature can be answered; that is, that the large and small grains compared, must be identical in all respects of manufacture, excepting only size of grain.

3. In what degree does density affect combustion, the powder being of equal sized grain?

4. How does difference in size of grain affect combustion?

5. Does any difference in the size of grains affect density?

6. Is a general equability of grain preferable to a variety of sizes of grain?

7. What is the effect of large grain powder, with percussion arms, and what small grain powder, and why?

18. There is a great risk with large grain powder, used with percussion arms, that ignition of the charge will become uncertain, as the large grains are less apt in ramming home the charge, to be carried into, or under, the cone of the nipple, than small grains. This evil was actually experienced when percussion arms were first introduced into this country; the powder therefore used for flint arms being found too large, and unfit for percussion arms, and for this reason the grain was reduced in size both at Home and in India. There appears a great disposition at present to increase the size of grain for the Minie rifle musket, and no doubt, theoretically, a right disposition, but we must be careful not so to increase it, as to risk certainty of ignition of charge. With a smooth bore percussion musket, the grain may be smaller and of quicker combustion than with the rifle, because, there is no "stripping" to apprehend, and the quicker combustion is indeed desirable with the former arm, because, as the bullet is a shorter time in the smooth bore barrel, consequent on higher velocity, than in the spiral grooves of the rifle barrel of the same length, there is shorter time for the full development of the charge, and therefore the necessity of quicker combustion. The friction of the grooves of the rifle barrel retards the velocity of the bullet in the barrel, it is requisite, therefore, to avoid "stripping" and injury to the form of the ball, that the force should act more slowly and continuously; for if the initial velocity of the ball in a rifle barrel exceed a given velocity, the ball is forced across the grooves, and "strips."

19. I will reply to these questions in the order in which they stand: density does affect the degree of fouling, because dense powder contains within the same compass or bulk, a larger quantity of nitre, charcoal, and sulphur, than a less dense powder of equal bulk, and, therefore, the denser powder receives more residuum, but only in the proportion of the difference of quantities of ingredients; the greater quantity the greater residuum, the lesser quantity the lesser residuum. This residuum consists of those component ingredients in gunpowder, which do not, on combustion, generate permanent gases, that is, the potassium, which is the base of the nitre, and the sulphur. These two bodies chemically unite at a high temperature, consequent on the inflammation of the powder, forming sulphuret of potassium, the chief residuum; which, with slight traces of unconsumed charcoal, sulphate and carbonate of potash, and sulphuretted hydrogen, constitute together what is termed "fouling."

20. The next question is, does size of grain exercise any influence on fouling? Certainly not; equal weights of powder of the same manufacture, whether in large or small grains, will leave equal residua, that is, equal fouling. If by the question general manipulations, the degree of purity of ingredients, nitre, charcoal, and sulphur, be included, then general manipulation does influence fouling, because if there be any impurities in these ingredients, these impurities will increase the fouling. I have before stated that size of grain, per se, cannot, and does not, influence the degree of fouling; and that equal weights of powder, whether the grains be large or small, will leave equal degrees of fouling.

21. The results of experiments recently conducted in England seem to verify the theoretical reasoning, that powder of fair, equal sized grain, that is, passing a 20 mesh to the linear inch sieve, and resting on a 34 or 30 mesh sieve, of moderate density, and moderate glaze, appears experimentally best adapted for rifle practice; and so also theoretically would this character of powder seem best adapted.

22. The reasons are given in reply to query No. 6.

23. That in which the ingredients exhibited the greatest purity and the charcoal used contains the greatest proportion of pure carbon, and when the quantity of sulphur used is only sufficient to saturate the quantity of potassium left by the nitre on combustion.

24. There is no contradiction; the conditions differ, and therefore the reasoning differs. Major Mordecai asserts, and all experience confirms that most able officer's views, that a small grain powder is best adapted for the smooth bore percussion musket; while, on the other hand, both experiment and theory seem alike to prove that a somewhat larger grain is better adapted for the rifled Enfield musket.

8. How does the density of powder, size of grain, and general manipulation act in reference to fouling the barrel, and does fine or coarse grain foul the most?

9. What kind of Powder, taking into consideration, the recent experiments conducted in England, America and India, do you, judging theoretically, conceive to be the best adapted for the Enfield Rifle, and support your opinion by authorities?

10. What kind of powder will leave the least residuum?

11. Major Mordecai asserts that small grain powder is best adapted for percussion arms, but it is to a great extent proved, that large grains answer best with the Enfield rifle; can you reconcile the apparent contradiction.

25. I have endeavoured to shew how both these positions are true. Vide reply to query No. 7.

26. We might conclude that, as both Madras and Bombay sieves are supplied by the same parties in England, the same designations to indicate the same things would also be used; but it appears not so, for the Bombay Proof report refers to a number of meshes quite unknown in the Madras manufactory; for instance, it alludes to a No. 576 meshes to the linear inch sieve.

12. Are the mesh sieves used here similar to those used at Bombay?

Vide Bombay experiment report on Waltham Abbey and Bombay powder, dated 31st May 1858.

27. Waltham Abbey, Bengal, and Madras, use the same designation of sieves.

28. The quality would depend on purity of ingredients, and character of manufacture, but I should regard with distrust so large a grain for any percussion arms. I should doubt whether the grains would be carried to the nipple cone, and if not, the ignition of the charge would be hazarded: a powder of this sized grain for small arms should be of moderate density and moderate glaze to facilitate combustion, and to insure the ignition of the whole charge before the bullet left the grooves.

29. In using the terms "moderate density" and "moderate glaze," I must explain that the Waltham Abbey powder, the standard powder of Europe, is of the gravimetric density of 875 ounces per cubic foot, and of high glaze: the English experiments suggest for rifles a somewhat less density and less glaze.

13. What do you conceive would be the quality of powder of uniform grain that stood on a 20 mesh sieve for rifle musket?

30. The future improvement of our powder will be found in the better means at length introduced at Madras for carrying on the several processes of manufacture, for instance:—

1. Coleman's cylinders for charring wood; in this process the charring is conducted on practically scientific principles, producing a charcoal perfectly fit for the manufacture of powder, which pit-burning, a most faulty process, hitherto carried out by ignorant village people, cannot produce, and indeed nothing but the faultless inherent character of the plant used for charring has enabled the Madras manufactory to produce the extremely good powder it has done, and now does. In England "pit-burnt" charcoal has been disused for the last 30 years for gunpowder purposes.

2. The new pressing, granulating, and winnowing machines will also greatly add to the manufacturing means of improving the powder—in fact, with the machinery now arriving from England, we shall work at Madras on the same conditions as at Ishapore and Bombay, that is, in close approximation to Waltham Abbey.

15. What would be the effect, if the powder made at Madras have more glaze?

31. Higher glaze would somewhat lessen the rapidity of ignition, a result which, with the Enfield rifle musket, may be considered desirable.

32. The higher glaze would also give a powder capable in a greater degree of resisting atmospheric moisture, and of bearing better the friction attendant on transport; it would also enable the manufacturer to give more completeness to the "dusting" process and produce a cleaner powder.

33. The chief differences between the powder now manufactured at Madras, compared with that of Waltham Abbey, may be briefly summed up as existing; 1st, in the degree of incorporation; 2nd the degree of density; 3rd, the degree of glaze; 4th, the method of drying: in all these the Madras powder exhibits these processes of manufacture in a less degree.

I have the honor to be, &c.,

(Signed) G. W. Y. SIMPSON, MAJOR,

Acting Principal Commissary of Ordnance.

ARSENAL, FORT ST. GEORGE, {
12th Augt. 1858. }

D.

44TH REGIMENT,
MADRAS, 18th November 1859.

No. 573.

SIR,—In reply to your letter of the 9th instant, requesting my opinion as to the quality of the Madras Gunpowder, I have the honor to inform you that, I can only give an opinion as to its adaptability for the Enfield rifle.

The Enfield rifle has sights affixed to it for ranges from 100 to 900 yards, calculated for a powder of a particular projective power, if a more projecting powder be used, the sights being adjusted to the distance, the bullets will go over the target, if less projecting the bullets will fall short. The Enfield rifle has its sights calculated for the force of English powder, with which powder it carries bullets well up. With Madras powder at the same elevation, the bullets invariably fall short.

Having caused experiments to be made in the Regiment under my command, by firing English against Madras Gunpowder at ranges from 500 to 900 yards, during which upwards of four thousand shots have been carefully aimed and registered, I am of opinion that, however fit Madras powder may be for other purposes, it is not adapted to the Enfield rifle, as the rifle is now sighted.

The rifles are sighted for the particular projective power of English service powder, and they would require to be entirely resighted to carry bullets up to the target with Madras ammunition, and even then, as the curve of flight of the bullets would be greater, their penetration would be less and aim less certain.

Experiment, No. "1" from the shoulder. I herewith enclose two series of Experiments (to be returned to me), one marked, No. "1" was conducted by Lieutenant Trimmer, late Instructor of Musketry of the Regiment, and was undertaken to test the merits of the new reduced diameter Rifle bullet fired with English and Madras powder, one against the other, from the shoulder, at 500, 750, 800 and 900 yards range. Diagrams of the targets, with the results of the firing at each range with each powder are attached to Lieutenant Trimmer's report, from which it will be perceived that the Madras powder does not send the bullets so well up to the Target at long ranges as the English; indeed, at 900 yards, nearly all the Madras ammunition fell short of the target.

This experiment being fired from the shoulder, each man very naturally made allowance for the short comings of the powder, and was emulated to hit the target if he could.

In No. "2" Experiment, each shot was fired from the same rifle, from a fixed heavy solid iron rest, supplied by the Woolwich Arsenal to the Arsenal of this Presidency, it was conducted by Quartermaster Hart and Color Serjeant Donelan under my own superintendence, to test the merits of the Madras powder as compared with English. The diagrams of the Targets shew the results of firing 100 shots with each powder at 700 yards, 100 shot with each powder at 800 yards and 90 shots with each powder at 900 yards range.

In this experiment, finding that the Madras ammunition invariably fell short at each range, it became necessary, in order to make it carry up to the Target at all, to use the 750 yards sight at 700 yards range, the 860 yards sight at 800 yards, and there being no sight on the rifles for distances beyond 900 yards, at this distance, the elevation was all guess work.

The diagrams marked "No. 1" "No. 2" show the short comings of the Madras ammunition, as compared with the English, favored even with an increase of elevation.

Several rounds went wide of the line of fire and made an unusual noise in their flight as if there was some defect in the bullet, thinking therefore that it was possible that the lead of which the Madras bullet is composed might be of a harder substance than the English, and if so, would not take the grooves of the rifle so readily, and consequently not carry so far, I caused a trial to be made of English against Madras made bullets, using English powder *with both*, but there was no perceptible difference beyond what might be caused by occasional instances of malformation of the bullet.

Commdg. H. M. 44th Regiment.

on Madras Powder.

E

Statement showing the comparative Equality of Ranges of Gunpowder of the three Presidencies as obtained at the Triennial Proofs, carried on at Saint Thomas's Mount.

			Musket Powder.												Cannon Powder.											
Year of proof.	Year of manufacture.	Manufacture.	1 lb. charge.			8 ozs. charge.			4 ozs. charge.			2 ozs. charge.			1 lb. charge.			8 ozs. charge.			4 ozs. charge.			2 ozs. charge.		
			Extremes of ranges.	Difference.		Extremes of ranges.	Difference.		Extremes of ranges.	Difference.		Extremes of ranges.	Difference.		Extremes of ranges.	Difference.		Extremes of ranges.	Difference.		Extremes of ranges.	Difference.		Extremes of ranges.	Difference.	
1846	1844	Bengal.....	667 635	32	300 297	3	144 139	5	78 76	2	831 826	5	347 336	11	149 145	4	84 77	7								
	1844	Madras.....	575 554	21	280 274	6	149 147	2	81 81	0	837 798	39	342 327	15	155 146	9	83 81	2								
	1844	Bombay.....	696 616	80	285 282	3	140 132	8	78 71	7	830 790	40	332 323	9	144 138	6	84 75	9								
	M. P. 1845 1848	Bengal.....	559 555	4	270 267	3	109 101	8	67 61	6	721 715	6	331 324	7	97 64	33	65 52	13								
1849	1848	Madras.....	568 560	8	269 267	2	128 119	9	71 69	2	714 702	12	334 316	18	126 107	19	76 69	7								
	1848	Bombay.....	569 567	2	290 286	4	125 110	15	74 66	8	775 772	3	327 324	3	135 129	6	77 75	2								
1853	1851	Bengal.....	537 525	12	265 261	4	138 136	2	68 64	4	722 712	10	311 308	3	145 142	3	75 74	1								
	1851	Madras.....	532 530	2	253 251	2	132 130	2	73 70	3	685 663	22	299 293	6	142 127	15	70 69	1								
1857	1851	Bombay.....	690 686	4	330 323	7	155 152	3	78 73	5	858 836	22	374 359	15	171 164	7	78 75	3								
	1857	Bengal.....	646 642	4	319 318	1	158 156	2	86 81	5	851 844	7	369 365	4	158 155	3	87 84	3								
1859	1857	Madras.....	611 605	6	273 272	1	134 132	2	70 69	1	747 735	12	320 320	0	133 130	3	76 72	4								
	1857	Bombay.....	712 708	4	371 369	2	184 184	0	96 94	2	942 936	6	415 412	3	203 196	7	102 98	4								

No. 8436.

BOMBAY, 15th December 1859.

FROM THE INSPECTOR GENERAL

of Ordnance and Magazines,

TO THE COMMANDANT OF ARTILLERY,

and President of the Special Commission,

MADRAS,

SIR,—I have the honor to acknowledge the receipt of your letter, dated the 2nd instant, requesting to be informed, what character the Madras gunpowder bears in Bombay.

2. In reply, I beg to state that, although the powder in question is considered inferior to that of Bombay and Bengal in appearance and range, yet it is practically a good serviceable powder and very equable in its performance. I would, however, remark that generally speaking, the powder sent round for triennial proof is found to be lumpy in the barrels, indicative of too ready absorption of external moisture.

I have the honor to be,

Sir,

Your most obedient servant,

J. M. GLASSE, LIEUT. COLONEL,

*Acting Inspector General of
Ordnance and Magazines.*

No. 9681.

FORT WILLIAM, ORDNANCE OFFICE,
22nd December 1859.

To

THE BRIGADIER COMMANDANT OF ARTILLERY,

MADRAS.

SIR,—With reference to your letter, dated 2nd December 1859, requesting my opinion of the gunpowder manufactured in Madras, in comparison with that made in the other Presidencies. I have the honor to refer you for full and detailed information regarding the quality of the powder to the Triennial Proof Reports of Powder of the three Presidencies, which must be available in the office of the Inspector General of Ordnance.

2. From these Reports it will be seen, that the range and penetration of Madras powder has been for some years past below that of Bengal and Bombay.

I have the honor to be,

Sir,

Your obedient servant,

E. W. S. SCOTT,

*Inspector General of
Ordnance and Magazines.*

[No. 126.]

No. 126. Copies

Proceedings of a Committee assembled at Saint Thomas' Mount, Madras, on Wednesday the 2nd day of November 1859, by order of His Excellency Lieutenant General Sir Patrick Grant, K. C. B., Commander-in-Chief in the Madras Presidency.

PRESIDENT.

Brigadier P. HAMOND, Commandant Madras Artillery.

MEMBERS.

Lieut. Col. JOHN M. ADYE, c. b., Commanding Royal Artillery, Madras Presidency.

,, E. BRICE, Madras Horse Artillery.

Captain T. H. CAMPBELL, Madras Artillery.

,, J. DESBOROUGH, Royal Artillery.

The Committee having assembled pursuant to order, President and Members all present, the order of Government No. 3021, dated 26th August 1859, assembling the Committee is read, as also the letter of the Adjutant General of the Army, No. 5652 of 23rd September 1859, addressed to the President, directing the Committee to investigate and forward a full report upon the quality of the Gun Powder, and strength of the Gun Carriages manufactured at Madras.

The Committee having concluded their investigation and report upon the quality of the Gun Powder, now proceed to the consideration of the second subject named in the letter of the Adjutant General of the Army, viz., "The strength of the Gun Carriages manufactured at Madras."

With a view of obtaining information on this subject, the Committee have investigated as far as possible the following points:—

1st.—The strength and quality of the materials used.

2nd.—The general construction and pattern of the carriages, and any important changes which have been made of late years.

3rd.—The results, as shewn by proofs of carriages, by their qualities in the field, by records of any failures or breakages which may have occurred, and by the opinions of officers of experience who have considered the subject.

STRENGTH AND QUALITY OF MATERIALS.

With regard to the first, the Committee find that for many years Teak was exclusively used for all parts of Madras Gun Carriages; but gradually and at various periods, objections were made to it, and other woods were recommended and tried for the more important parts such as the trails, cheeks, wheels, &c.

Owing, however, to the difficulty of obtaining sufficient supplies of other Indian woods, such as Saul, Peddowk, &c., which also require many years before they become seasoned and fit for use, Teak has until lately been continued as the chief material in the manufacture.

Lieutenant Colonel Simpson, Madras Artillery, Acting Inspector General of Ordnance, who has considered the subject of timber for Gun Carriages, and has reported upon it at various times, is of opinion, that the Teak which has been obtained of late years is of an inferior quality to that formerly used, and to this he attributes the failures which have occurred, and the reports which have been made against it. He states that the Teak formerly used was obtained from the hill ranges of the Malabar forests, and was of excellent quality.

As this supply became exhausted, having been extensively drawn upon for Naval purposes at Bombay, the forests of the low lands were resorted to, and also those of Burmah; but in both cases an inferior timber was obtained, owing to the locality in which the wood was grown. He is decidedly of opinion that Teak grown in hilly spots is slower in growth, and therefore stronger and better than that grown in the vallies. Writing in 1848, he quotes the following opinions corroborative of his own, as to the inferiority of Teak grown in the low countries.

Mr. Munro, Conservator of Forests says, "The Teak which grows on the sides and tops of hills is far superior to that which grows in the black heavy soil of the low grounds."

Mr. Edye, Survey Department of the Royal Navy, alluding to Moulmein timber writes:—

"This timber, as well as that before described, grows on a rich deep soil, and consequently its maturity is rapid."

Colonel Frith, formerly Superintendent of the Gun Carriage Factory, writes to the effect, that an open porous grain, great pithiness and sponginess, is general to woods grown on swampy grounds where growth is rapid.

In a joint report furnished to the Committee by Colonels Balfour and Simpson and Major Black, all experienced Officers of the Madras Artillery, it is stated that:—

"The breaking weights of fine Teak of slow growth from uplands is from 900 to 1,000 lbs.; whereas 600 or 700 lbs. may be considered the breaking weight for the rapid growing Teak produced in marshy and moist localities."

The Committee find that Teak has been constantly spoken of as being objectionable for Gun Carriages for many years past; chiefly it would appear, from its being of a brittle nature. The special Board of Artillery Officers which sat in Calcutta in 1838 and 1828, having made experiments, are particularly decisive on the subject. They say:

"The result of these experiments, however, leads the Board strongly to recommend to Government, that Teak-wood should never be used for cheeks, axletrees, beds, or any parts of the wheels of Gun Carriages; but rather that the same kinds of wood should be used as in Bengal, unless on inquiry equally good wood can be found contiguous to the other Presidencies. The superiority of Saul for cheeks is manifest, except in the instance of its specific gravity; but the Board think this more than compensated for by its other qualities, and especially its durability, until as good a wood with less specific gravity may be found out."

Again, they say:—

"We have already recorded in our proceedings, our opinion of the unsuitability of Teak in general use under the Madras and Bombay Presidencies, for Light Field Artillery Carriages."

"The proceedings of this Board, and others that have been laid before them, it is conceived, bear ample testimony of the inefficiency of the present carriages for service at all the Presidencies, and it has come to their knowledge, that within a very recent period, three Light Field Artillery carriages broke down in one morning at Dumdum, when firing the ordinary service charges."

Lieutenant Curran, Deputy Assistant Commissary of Ordnance, who has been employed for many years in the Madras Gun Carriage Factory, gave evidence before the Committee, and states, that from his experience Teak obtained in the present day is quite as good as that formerly used, and that it bears the same tests; but he considers, that Teak is not altogether the best wood for Light Field Gun Carriages, owing to its brittleness.

Mr. Bowman, Conductor in the Manufactory, gives a similar opinion.

The Committee find that Teak-wood was finally ordered to be discontinued for the beams or trails of Carriages in 1854, and that at present the component parts of carriages are constructed as follows:—

Beams.....Rosewood, Saul, or Peddowk.
Cheeks.....Teak.
Axletree cases.....Teak, Saul, or Peddowk.
Poles.....Trincomallee, Saul, Peemah, or Peddowk.
Boxes.....Teak.

Spokes and Fellies. Teak, Peddowk, or Peemah.

Lieutenant Colonel Maitland, Superintendent of the Gun Carriage Factory, states, that Teak will gradually be still further superseded.

From tables furnished by Colonel Maitland, the breaking weights of the chief woods appear to be about as follows:—

3 trials. Average.
Peddowk..... $\left\{ \begin{array}{l} 1056 \\ 1112 \\ 907 \end{array} \right\}$ 1025 lbs.

Trincomallee..... $\left\{ \begin{array}{l} 963 \\ 1038 \\ 926 \end{array} \right\}$ 976 lbs.
Saul..... $\left\{ \begin{array}{l} 1000 \\ 888 \\ 851 \end{array} \right\}$ 913 lbs.
Rosewood..... $\left\{ \begin{array}{l} 851 \\ 926 \\ 888 \end{array} \right\}$ 888 lbs.
Pegu teak..... $\left\{ \begin{array}{l} 776 \\ 888 \\ 1000 \end{array} \right\}$ 888 lbs.
Peemah..... $\left\{ \begin{array}{l} 926 \\ 888 \\ 856 \end{array} \right\}$ 888 lbs.

The specific gravities, as furnished by Lieut. Colonel Maitland, are:—

Peddowk.....56.6
Saul.....56.1
Rose.....50.5
Teak.....45.0

With respect to seasoning the timber used in the carriage department, the Committee inspected the covered stores, which seem airy and of equable temperature, and well arranged; and in the joint report of Colonels Balfour and Simpson and Major Black, (already quoted), the system pursued is considered satisfactory.

In Appendix A, is a statement also furnished by Lieut. Colonel Maitland, of the places from which the various woods are obtained and of the time required for storing and seasoning each description.

The Committee made enquiries as to the manner of testing the timber on being received into the Factory and find that three logs are taken indiscriminately from each batch received, and that three experimental pieces are cut from each of these logs, which are tested by suspending them on two trestles, weights being added to a scale-pan, which is suspended from the centre of the pieces.

IRON WORK.

With respect to the iron work, the Committee find that formerly the axletrees of the Madras Light Field Gun Carriages were made of rolled iron, and occasional breakages are recorded, details of which will be found in Appendix D, but that since 1857 the axletrees have been made of hammered scrap iron sent from England, which, in the opinion of Lieut. Colonel Maitland, is an improvement, and no failures have occurred since that date.

The Committee have also had the advantage of the opinion of Mr. W. B. Wright, Locomotive Superintendent of the Madras Railway, who having inspected the process of manufacture, states:—

"That the process of forging the axletrees is as efficient as is compatible with the means, and the system in use at the Manufactory, and I see no reason why they should not be manufactured as sound in the Madras Gun Carriage Manufactory as they would be in England, provided the best description of iron is used."

Mr. Wright goes on to say:

"When the steam hammer is put to work the facility of manufacture will be greatly increased, whilst the good quality of the iron may be ensured by its being made from scrap iron in the Government Manufactory."

Several of the axletrees, as well as some of the Royal Pattern made in England, were submitted to severe experiments in presence of the Committee, at which Mr. Wright also attended, and the result proved that both in material and manufacture, the Madras axles were excellent, and able to sustain greater strains and shocks than any that they would be likely to receive on actual service, and stood the trials equally well with those of the Royal pattern. Weights of 300 lbs. were dropped upon them repeatedly from a height of eight feet, which only broke them after many successive blows.

CONSTRUCTION OF THE CARRIAGES.

With respect to the second part, *viz.*, the general construction and pattern of the carriages, the Committee find that many changes, (some of which are of an important character,) have taken place in the patterns and construction of the Light Field Gun Carriages during the last 20 years. They have consulted the voluminous records of the Madras Artillery Select Committee upon the subject, and find that the principal changes and patterns have been as follows:—

Date.	Name of Pattern.	Remarks.
Previous to 1836...	Colonel Cullen's pattern.....	Open check trail.
1836...	Special Board's do.	do.
1842...	G. O. G. or Governor General's do. called also the Royal pattern block trail Carriage.	Block Trail.
1845...	Select Committee pattern.....	do.
1853..	Established pattern, (an assimilation of the Royal)...	do.

The first, named Colonel Cullen's pattern, appears to have been a serviceable carriage, and its general features were adopted in their new patterns by the Special Board of Artillery Officers which assembled at Calcutta in 1836, for the purpose of assimilating the Artillery Equipment of the three Presidencies—this latter carriage was also a good model, but objected to from its weight. In 1842 another change took place, and a carriage of a different pattern was ordered by the Governor General. Strong objections were, however, at once made to it by Officers of Madras Artillery. It was represented as too heavy, too wide in the axletrees, the weight on the horses necks was greater than before, and the wooden Naves were thought objectionable.

In consequence, of these representations, and after considerable discussion and experiments, another model was adopted in 1845 for this Presidency, called the Select Committee pattern. This, however, also failed to meet its requirements, and to give satisfaction, and was a very heavy carriage. Finally, in 1853, the present, which is called the established pattern, was adopted. The iron and wood work were reduced, and the carriage is considerably lighter than any of the former ones. Appendix B, shews the weights of the several patterns for each calibre.

Such is a short account of changes and of discussions upon this question, which have been carried on for years.

With respect to the present pattern of carriages, Lieutenant Colonel Maitland is of opinion, that it would be strengthened and improved by adopting that of the Royal Artillery in the following particulars, *viz.*

- 1.—In the dimensions of the beams, those of the Madras pattern being generally smaller, and also in the introduction of humps at the elevating screws for 6 and 9 powder Guns.
- 2.—In the introduction of the same number of bolts.
- 3.—In the dimensions of the cheeks and axletree cases, both of which are considerably less in the Madras patterns.
- 4.—In the cheeks being tabled instead of dovetailed, as at present, to the beams.
- 5.—In the adoption of a bent, instead of a straight axletree.

Mr. Wright, Locomotive Superintendent of the Madras Railway, in giving his opinion of the ironwork, coincides as to the model of the Royal Artillery axletree being superior.

Mr. Curran, of the Gun Carriage Manufactory, agrees generally with Lieutenant Colonel Maitland's proposals.

In Appendix C, will be found the comparative dimensions of the Royal and Madras carriages furnished by Lieutenant Colonel Maitland, and his remarks upon each part.

Lieutenant Colonel Barrow, Madras Artillery, Principal Commissary of Ordnance, who was asked by the Committee for an opinion upon the carriages, considers,

“That the present scantling is sufficient under the conditions of good workmanship and good material being employed on the part of the manufacturer; and thorough care being exercised on the part of the officers in charge of the carriages.”

RESULTS.

With regard to results, the Committee have drawn up a Table, from records furnished them (Appendix D), shewing the number of Madras Field Gun Carriages which have been made of each pattern and calibre, during the last 20 years, the wood of which they were constructed, how many have failed, and in what parts.

From this table it appears that of 358 constructed, 43 have failed, principally in the beams and axletrees.

The general abstract is as follows:—

	Made.	Failed.
9 Pounder Carriages.....	112	15
6 " " ".....	84	6
24 " Howr. Carriages.....	104	21
12 " " ".....	58	1
Total.....	358	43
Of the Failures. { 26 were in the Beams. { 9 axletrees gave way. { 14 were of less importance. } Some of these carriages failed in beams and axletrees also.		

Of Colonel Cullen's pattern	10	were made of which	1	failed
„ Special Board's do.	67	do. do.	5	do.
„ G. O. G. do.	8	do. do.	4	do.
„ Select Committee do.	67	do. do.	11	do.
„ Experimental do.	1	do. do.	1	do.
„ Established do.	205	do. do.	21	do.
Total.....	358		43	

Lieutenant Colonel Barrow, Madras Artillery, considers the chief breakages occur in the 24 Pdr. Howr. Axletrees; but his general opinion of the carriages, especially after his late experience in the field, is that they stand well under the severe tests to which they are subjected.

Colonels Balfour and Simpson, and Major Black, Madras Artillery, in their joint report, give a decided opinion, that the proportion of breakages in the Madras Gun Carriages has been greater of late years, than it ought to have been; and they attribute the failures chiefly to the use of inferior teak in the manufacture.

Lieutenant Colonel Maitland, Superintendent of the Gun Carriage Factory, states that the chief breakages in the trails occur at the weakest part, between the point touching the ground and the elevating screw, and he advocates that part being strengthened by bolts.

With regard to the failures in the axletrees, it is his opinion, that they proceed chiefly from want of substance in the axletree cases. (Vide his remarks upon this point in Appendix C.)

OPINION.

The Committee having, as far as possible, investigated the several points connected with the subject under consideration; are of opinion, that Teak is an objectionable wood for the principal parts of Light Field Gun Carriages, owing to its brittleness, and that its use should be still further restricted, especially as regards the cheeks, unless teak of the first quality can be obtained.

By reference to Appendix D, it will be observed, that in many instances the beams of carriages made of this wood, of the established pattern, have broken, some even at proof, and this wood is evidently therefore unfit for beams of the present scantling and construction. Saul appears undoubtedly the best wood for the most important parts of Carriages. Peddowk seems open to some objections and further experience is required before a decided opinion can be given respecting it.

The mode of testing the timber on being received, as already described, is satisfactory, as far as it goes; but the Committee consider that the selection of only three logs for the purpose, out of each batch, is quite insufficient to enable any opinion to be formed as to the general quality of the wood, and recommend that each log be tested separately, as the quantity of wood required for this purpose is very small.

With regard to the iron work, although the material and workmanship appear to be satisfactory; still as a Nasmyth's hammer is now lying at the Carriage Factory, the Committee agree with Mr. Wright, in his recommendation that it should at once be set up and made use of.

With regard to the present pattern of Carriage, the Committee are of opinion, that in scantling and dimensions, it is insufficient; that strength has been sacrificed to lightness, and that generally the proportions and construction of the Royal pattern should be adopted, as recommended by Lieutenant Colonel Maitland, viz., in the beams, cheeks, and axletree cases; and in the introduction of humps for the 6 and 9 Pdr. Carriages; also, that the cheeks should be tabled, instead of being dovetailed to the beams.

They advocate the adoption of the same number of bolts as in the Royal carriage, and of the bent instead of the straight axle.

The Committee further recommend, that the iron work of the trunnion boxes and plates be assimilated in dimensions to the Royal pattern. The only differences which will then exist between the two patterns, will be in the modifications necessary to meet the differences in size of the ordnance in use, with the two services.

The Committee do not consider it necessary to make any alteration in the wheels, beyond the slight modification which will be required to meet the proposed bend and form of the axletree arms.

In conclusion, the Committee, in considering the proportion of breakages which have taken place in the last 20 years, as set forth in Appendix D; are of opinion, that it certainly is greater than it ought to have been; but without the means of making comparisons with carriages constructed at other Factories, it is difficult to draw a satisfactory conclusion on this point.

They cannot, however, help remarking on the numerous changes of pattern and construction which have occurred during that time, some of which seem to have been of very doubtful utility, and may account for the many failures that have taken place.

(Signed) P. HAMOND, Colonel,

President of Committee.

MEMBERS.	{	" JOHN ADYE, Lieutenant Colonel, <i>Royal Artillery.</i>
		" E. BRICE, Lieutenant Colonel, <i>Madras Horse Artillery.</i>
		" T. H. CAMPBELL, Captain, <i>Madras Artillery.</i>
		" J. DESBOROUGH, Captain, <i>Royal Artillery.</i>

Statement showing the sources from which the undermentioned Timber is obtained and the mode of storing and seasoning it in Logs and half Wroughts.
at the Gun Carriage Manufactory.

APPENDIX A.

Names of Woods.	Sources from whence obtained.	Period of seasoning in log.	Period of seasoning in half wroughts.	Mode of storing and seasoning Timber at the Gun Carriage Manufactory.
Peddock.	Burmah.	5 to 6 years.	{ 2 to 3 years for large component parts and 18 months for small.	The timber in log is piled up and left in the open air to season. The timber in half wroughts are seasoned in half wroughts, sheds, well ventilated, every component part being skidded, to allow a current of air to pass between each.
Trincomallee.	Ceylon.	2 years.	{ 12 months.	
Saul.	Cuttack and Bengal Provinces.	6 do	{ 3 years for large component parts and two years for the smaller.	
Rose.	Anamullay forest in the Coimbatore district.	3 do	18 months.	
Teak.	Burmah, Annamullay forest and Malabar Coast.	5 to 6 years.	{ 18 months for larger component parts and 12 months for the smaller 1 to 2 years.	
Peemah.	Burmah.	2 years.	{ 2 to 3 years for large component parts and 18 months for smaller.	
Satin.	Southern India and Ceylon.	5 to 6 years.	{ 2 to 3 years for large component parts and 18 months for smaller.	
Baobool.	All over India.	do	{ 2 to 3 years for large component parts and 18 months for smaller.	

GUN CARRIAGE MANUFACTORY,
MADRAS, 16th November 1859.

(Signed) J. MAITLAND, Lieut.-Colonel,
Supt. Gun Carriage Manufactory.

B.

Table shewing the Weights of the Madras Field Carriages.

Pattern of Carriage.	Calibre and weight of gun.	Weight of Carriage.	Of what Wood constructed.
	cwt. qr. lbs.	cwt. qr. lbs.	
Special Board's pattern 1838.	9 pr. gun 10 0 2	11 2 2	Teak.
	24 howr. 9 3 14	14 0 7	
	6 pdr. gun 5 3 25	11 3 16	
	12 howr. 6 1 20	11 0 27	
G. O. G. pattern 1842.	9 pr. gun 10 0 9	12 1 15	Teak.
	24 howr. 9 3 20	13 1 16	
	6 pdr. gun 6 0 0	11 3 26	
	12 howr. 6 2 1	12 3 16	
Select Committee pattern 1845.	9 pr. gun 10 0 3	13 3 16	Teak.
	24 howr. 10 0 4	14 3 15	
	6 pdr. gun 5 3 20	11 1 10	
	12 howr. 6 2 9	14 1 4	
Established pattern 1854.	9 pr. gun 9 3 14	10 2 22	The beams were of Teak, but are now Peddowk.
	24 howr. 9 3 4	11 2 0	
	6 pdr. gun 5 3 12	10 0 23	
	12 howr. 6 2 6	11 0 14	

APPENDIX C.
Statement shewing the differences existing in dimensions, between the Royal and Madras Pattern Carriages.

	Royal Artillery Pattern.				Madras Pattern.				Remarks.
	6 Pdr.	9 Pdr.	12 Pdr.	24 Pdr.	6 Pdr.	9 Pdr.	12 Pdr.	24 Pdr.	
Check, vertical bolts.....	5	3	3	3	4	3	3	3	The Madras carriages are not bound with so many bolts as in the R. A.; consequently, they cannot so effectually resist the shocks in turning and travelling. I would therefore suggest the introduction of the same number of bolts in the Madras, as in the Royal pattern.
do, horizontal bolts.....	8 7 1/2	10 9	9 1 1/2	5 4	8 9 1/2	10 8 1/2	9 1 1/2	4 2	
Beam, vertical bolts at the axletree in front of the elevating screw.....	8	9 1/2	9 1/2	4 4	10 1/2	9 1/2	8 1/2	3 1	
No. of bolts passing through the axletree.....	7 1/2	8 1/2	8 1/2	3 3	8 1/2	8 1/2	8 1/2	3 1	
Length of beam from centre of axle to the point of the trail touching the ground...inches.	105	109	108	92 1/2	103 1/2	108	106	88 1/2	The dimensions of the beams of the Royal pattern are in most respects greater than those of the Madras pattern; particularly so, where great strength is required, and consequently the carriages must be stronger than the Madras pattern. I recommend that the dimensions of the Royal Artillery be substituted, wherever they are larger than our carriages.
Total length of beam.....	8	9 1/2	9 1/2	110	7 1/2	7 1/2	8 1/2	8 1/2	
Beam depth at breast.....	6	6 1/2	6 1/2	10 1/2	5 8	5 8	5 8	5 8	
do. hump.....	7 1/2	8 1/2	8 1/2	9 1/2	6 1/2	6 1/2	6 1/2	6 1/2	
do. centre.....	9	10 1/2	10	11 1/2	8 2	9 7	10 2	11 1/2	The same remarks on the beams may apply to the cheeks and axletree case.
do. trail.....	9	10 1/2	10	11 1/2	8 2	9 7	10 2	11 1/2	
do. centre.....	6	6 1/2	6 1/2	7 1/2	6 1/2	6 1/2	6 1/2	6 1/2	
do. trail.....	42	49 1/2	46 1/2	54 1/2	42	42	42	42	
Check length.....	12	12 1/2	13 1/2	14 1/2	11	11 1/2	11	13	The cause of breaking of our axles may in a great measure be attributed to the want of substance, to act as a buffer between the axletree, and the cheeks and beams. In the Madras pattern the thickness of wood at that part is only 1 1/2 inches, while in the Royal pattern it averages from 4 1/2 to 5 inches.
do. greatest breadth.....	2 1/2	3 1/2	3 1/2	4 1/2	3	3 1/2	3 1/2	3 1/2	
do. thickness.....	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	
Axletree case length.....	6 1/2	7 1/2	7 1/2	7 1/2	6 1/2	6 1/2	6 1/2	6 1/2	
do. breadth.....	6	6 1/2	6 1/2	6 1/2	6	6	6	6	The cause of breaking of our axles may in a great measure be attributed to the want of substance, to act as a buffer between the axletree, and the cheeks and beams. In the Madras pattern the thickness of wood at that part is only 1 1/2 inches, while in the Royal pattern it averages from 4 1/2 to 5 inches.
do. depth.....	4 1/2	5	4 1/2	5	4 1/2	4 1/2	4 1/2	4 1/2	
Thickness of the axletree case, between the axletree and the beam and cheeks.....	4 1/2	5	4 1/2	5	4 1/2	4 1/2	4 1/2	4 1/2	
Axletree.....	Arms.....	Arms.....	bent.....	Arms.....	Arms.....	Arms.....	Arms.....	Arms.....	

(Signed) J. MAITLAND, Lieut. Colonel,
Superintendent Gun Carriage Manufactory.

GUN CARRIAGE MANUFACTORY,
MADRAS, 16th November 1859.

Return shewing the number of Madras Field Gun Carriages which have been made during the last 20 years, of what wood constructed, how many have failed and what parts, of the carriages have given way.

9 PDR. CARRIAGES.

PATTERN.	Wood of which made.	Year in which made.	No. made.	No. of failures.	Average of service of the failures.	Nature of Breakage.
Colonel Cullen's	Teak.	1840	10	1	15 years.	Axletree broke.
Special Board....	Teak and Saul.	1840 to 1843	24	0		
G. O. G.....	Teak.	1844	4	4	5 years.	Checks split in all 4 cases and also the beams.
Select Committee ...	3 Peddowk. 13 Teak.	1848 to 1852	16	4	7 years.	Beam broken in all 4 cases.
Experimental....	Teak.	1852	1	1	6 years.	Beam broke.
Established.....	Teak and Peddowk.	1853 to 1859	57	5	The three Beams broke in proof.	3 beams broke made of Teak, 1 axletree bed broke, and 1 beam of Peddowk split.

ABSTRACT OF 9 PDR. CARRIAGES.

112 Carriages made, of which 15 failed. { 13 were serious.
2 not so important.

15

6 PDR. CARRIAGES.

G. O. G.....	Malabar Teak.	1844	4	0		
Select Committee ...	...	1845 to 1849	21	0		
Established.....	Malabar Teak, Peddowk and Saul.	1853 to 1859	59	of Teak 6	3 years	All the beams broke.

ABSTRACT OF 6 PDR. CARRIAGES.

84 Carriages made, of which 6 failed, all serious.

24 PDR. HOWITZER CARRIAGES.

PATTERN.	Wood of which made.	Year in which made.	No. made.	No. of failures.	Average of service of the failures.	Nature of Breakage.
Special Board.....	Malabar Teak.	1840	53	5	7 years.	All the failures were in the checks which split.
Select Committee.....	Teak.	1848 to 1852	18	7		All gave way in the beam and one axletree.
Established.....	Teak, Saul and Peddowk.	1853 to 1859	53	6 Teak. 1 Saul. 2 Peddowk.		5 axletrees gave way and 5 beams also; the 1 Saul and 2 Peddowks both trivial.

ABSTRACT OF 24 PDRS.

104 Carriages made, of which 21 failed. { 13 were serious.
8 not so much so.

21

12 PDR. HOWITZER CARRIAGES.

Special Board.....	Malabar Teak.	1840 to 1842	10		
Select Committee.....	Moulmein Teak.	1848 to 1852	12		
Established.....	Teak and Peddowk.	1853 to 1859	33	1	Axletree broke.

ABSTRACT OF 12 PDRS.

58 Carriages made, of which 1 failed.

ABSTRACT.

	Made.	Failed.	
9 Pr. carriages....	112	15	
6 " " " " " "	84	6	
24 Howr. " " " "	104	21	
12 " " " " " "	58	1	
	358	43	

Of the failures, ... { 26 were in the beams,*
9 axletrees gave way,
14 were of less importance. } * Some of these Carriages failed in beam and axletree also.

Of Colonel Cullen's pattern-	10	were made of which	1	failed.
„ Special Board....	do.	67	do.	5 do.
„ G. O. G.....	do.	8	do.	4 do.
„ Select Committee.	do.	67	do.	11 do.
„ Experimental....	do.	1	do.	1 do.
„ Established.....	do.	205	do.	21 do.
		358		43

MADRAS RAILWAY.

LOCOMOTIVE DEPARTMENT,
ENGINEER'S OFFICE,
MADRAS, 23rd January 1860.

From WILLIAM BARTON WRIGHT, Esq.,

Locomotive Superintendent, Madras Railway.

To THE PRESIDENT AND OFFICERS OF THE COMMITTEE

on Ordnance Carriages, &c.

GENTLEMEN,—In compliance with your request, I beg to forward you such observations as I have to make, on the experiments made under your inspection in my presence at the Gun Carriage Yard, on Wednesday the 11th instant, for the purpose of testing the comparative strength of axletrees made in the Madras Gun Carriage Manufactory, and those manufactured in England.

2. The accompanying tabular Statement shows the actual results of the tests on each description of axletree, and it will be seen thereby, that the axletrees manufactured at Madras, stood without exception the tests, without exhibiting any flaw whatever, either in the workmanship or in the material; whilst one of the Royal Artillery axles failed immediately, and broke at the third blow.

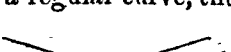
3. The result of these experiments, as shown on the table, might lead to the inference, that the axletrees manufactured in India, are superior to those manufactured in England; but my opinion is, that the case of the first Royal Artillery axletree being unsound, is exceptional, and I do not therefore, think, it would be fair to draw any conclusion unfavourable to the manufacture of the Royal Artillery axles in general, from the fact of this particular axletree having failed.

4. Indeed, the results of the test of the second Royal pattern axletree must have convinced you of the general excellence of its material and manufacture. The quality of the metal was unexceptionable; but it was clear that the axles had been forged in two distinct parts, and then welded in the middle, and the failure of the first axle was solely attributable to the imperfection of the weld, the axletree having given way from the opening of the scarf where it had been welded.

5. The second axle also opened slightly in the same way; showing thus, that the system of making the axles in two parts and then welding them together, is not so reliable as that of forging them solid.

6. The first Madras made axletree that was tested, stood remarkably well, and afforded convincing proof of the soundness of its manufacture, the metal was also of excellent quality; but the bar of iron from which it was made, had evidently been made from bars of iron faggoted together; that is to say, from bars of iron piled together longitudinally and welded into a mass. The result of this was, that the iron opened in layers running lengthways in the axletree, and when the axletree bent from the blows it received, the under part, or that which formed the outside of the curve of the bent axle, began to open in the fibre, and the under layer of iron was broken right through, before the upper one began to open.

7. The same appearances characterized the experiment with the second Madras pattern axletree.

8. The Royal pattern axletree showed no such opening of the metal lengthways, as shewn in the Madras axletrees; and this difference resulted, in my opinion, from the Royal pattern axletree being made out of scrap iron, or from a medley of small pieces of iron of a variety of shapes and sizes, welded together under a steam or tilt hammer. The mingling of the fibres of iron thus manufactured, gives great strength to the bar produced, and I would call the attention of the Committee to a fact which I pointed out at the time of the experiment, namely, to the difference of the curvature described by the Royal and Madras axletrees, when yielding to the blows dealt them. The Royal pattern bending in a regular curve, thus  the Madras axle bending at an angle in the centre, thus . This difference, I ascribe entirely to the difference I have just pointed out in the manufacture of iron from scrap and from

faggoted bars. The Royal axletree bent as one piece, and could only bend as the fibres on the outside of the curve described throughout its length opened out, and as the fibres on the inside were compressed. The Madras axletree bent as two or more pieces of separate iron would bend, the outer layer opening and breaking right through, the inner layers bending; the outer layers, from its separation from the under layer, losing the support it would receive from it, both in resisting the opening out of the fibres on the one side, and of the compression of the fibres on the other.

9. In my opinion, there can be no doubt of the great advantage that the Gun Carriage Manufactory will possess, when the steam hammer is put to work; not only in the forging of axletrees, but also in the manufacture of the iron itself; the quality of which may be ensured by being made out of the best scrap. I had some conversation with Mr. Ingle, who is evidently a first class Forgerman, and under his superintendence, there is no doubt that forgings could be turned out from the steam hammer in the Gun Carriage Yard, equal to any in the world.

10. With reference to your inquiries as to the system of seasoning Timber, as followed out in the Gun Carriage Manufactory; I regret, that my experience of Indian wood is too limited, to enable me to offer any confident opinion; but so far as I am able to judge, I should think the time allowed for seasoning the timber generally, is ample; whilst it is evident, that great care is devoted to the process.

I have the honor to be,

Gentlemen,

Your most obedient servant,

(Signed) W. BARTON WRIGHT.

No. of Trials.	Description of Axletrees.	Height from whence the weight was dropped.	Weight used.	Momentive Force.	Deflection.	Remarks.
1	Royal Pattern, 24 pounder howitzer.....	8 feet	72 lbs.	1,622 lbs.	none	
2	do. do.	5½ feet	300 lbs.	5,472 lbs.	1½	A slight fracture in the middle caused by the opening of the scarf.
3	do. do.	8 feet	300 lbs.	6,762 lbs.	none	Broken entirely.
1	Established Pattern for all calibres.....	8 feet	72 lbs.	1,622 lbs.	do.	
2	do. do.	5½ feet	300 lbs.	5,472 lbs.	1½	A very slight fracture.
3	do. do.	8 feet	300 lbs.	6,762 lbs.	3½	do.
4	do. do.	8½ feet	300 lbs.	6,912 lbs.	4	do.
5	do. do.	8½ feet	300 lbs.	6,984 lbs.	7½	do.
6	do. do.	8½ feet	300 lbs.	7,080 lbs.	8½	do.
7	do. do.	8½ feet	300 lbs.	7,080 lbs.	9½	do.
8	do. do.	8½ feet	300 lbs.	7,080 lbs.	12½	Broke half way.
9	do. do.	8½ feet	300 lbs.	7,080 lbs.	15½	do.
1	Royal Pattern, 24 pounder howitzer.....	5½ feet	300 lbs.	5,472 lbs.	1½	
2	do. do.	8½ feet	300 lbs.	6,984 lbs.	4	
3	do. do.	8½ feet	300 lbs.	6,984 lbs.	5½	Scarf slightly opened at the middle of the body.
4	do. do.	8½ feet	300 lbs.	6,984 lbs.	7½	do. do.
1	Established Pattern for all calibres.....	5½ feet	300 lbs.	5,472 lbs.	1½	
2	do. do.	8½ feet	300 lbs.	6,984 lbs.	3½	
3	do. do.	8½ feet	300 lbs.	6,984 lbs.	5½	
4	do. do.	8½ feet	300 lbs.	6,984 lbs.	7½	A slight fracture.
1	Assimilated Madras Pattern	8½ feet	300 lbs.	6,984 lbs.	1½	
2	do. do.	8½ feet	300 lbs.	6,984 lbs.	2½	

11th January 1860.

(Signed) W. BARTON WRIGHT.

P. M. 20th Decr / 59 m. 31-72.

P. M. 1860 Report
Pro of Govt 20th April
No. 905

103-704
748-706

Copy to Mr. Chief Engineer
with Govt. Secy. at G. O. 1863
17th Apr / 60
J. A. G. G. G.

Proceedings of the Madras
Govt in the Military Dep^t.

Dated 23rd March
Received 14th Apr^l } 1860.

From - No. 18th July 1863.
C. 185837 in R. 185837 25 July
Observing that on a site
being selected by the Command-
er in Chief, the Chief Eng^r will
be called on for Plans & Estimates
for all buildings required
for the Gun Powder Manufac-
tory, and sanctioning the
Estimate for the building to
set up the Steam Engine Hammer,
for immediate execution
in anticipation of its being
passed by the Gov^t of India.

Chief Engineer for information and guidance with
reference to form 6.
No. 790.
Enclosed to be communicated to the

W. A. G. G.

No. 29 + 130

No. 790. 17th April
With an Order L

Decr 14 1860