

Handwritten scribble or signature in the top left corner.

WASC 18

Memo on GC.

FA Abel

11-1870

WASC
~~174~~
184

F.A. Abel
Memorandum on guncotton. For the Director
of Artillery. 18th November 1870.
(Copy typed in ERDE 1963)

F. A. Abel
Memorandum on Guncotton.
For the Director of Artillery.
18th November 1870.
(Copy typed in ERDE 1963)

E.R.D.E. LIBRARY
WALTHAM ABBEY, ESSEX.

Library No.

WASC 184
~~174~~

MEMORANDUM ON GUNCOTTON

MEMORANDUM ON GUNCOTTON

1. In February 1862 the Austrian Government offered to communicate to Her Majesty's Government, confidentially, the details regarding the manufacture of Gun Cotton and its proposed application to Artillery, Small Arms, and Mining & Engineering purposes, as elaborated chiefly by Baron von Lenk, from the data originally furnished in 1846 by the discoverer of Gun Cotton M. Schonbein.
2. Mr. Abel was first communicated with, relative to this offer by the late Sir B. Hawes and Sir H. Storks, and ultimately Major (now Lieut. Colonel) C.F. Young, R.A. was sent to Vienna to inspect the experimental Guncotton Factory at Hirtenberg, and to collect such information regarding the production and application of this material as the Austrians were disposed to furnish.
3. Major Young's Reports were submitted to the War Department Chemist by desire of the Secretary of State for War, and Mr. Abel was instructed to examine into the merits of the system of manufacture as pursued in Austria, and to institute investigations upon the stability of Guncotton and its susceptibility of application to warlike purposes.
4. In 1862 the British Association for the Advancement of Science appointed a Committee of Chemists and Engineers to examine into the merits of the Austrian method of producing and applying Guncotton, which had been patented in this country, and sometime afterwards Mr. Abel was authorised by the Secretary of State for War to communicate to that body the main features of the information received from the Austrian Government and the results arrived at by him in his experiments at Waltham Abbey and Woolwich, commenced in 1862, on the manufacture and properties of the material. This he did at the Newcastle Meeting of the Association in 1863, his Reports being published in the proceedings of the Society.
5. In consequence of communications between the Government and the British Association, the Secretary of State appointed (in Feb. 1864) a Committee under the Presidency of Sir Edward Sabine, President R.S. consisting partly of members of the British Association, and partly of Government Officers, "to enquire into the properties of Guncotton as a substitute for Gunpowder".
6. This Committee requested Mr. Abel to continue the investigations which he was carrying on into the manufacture, composition and properties of Guncotton, and the results of his labours were embodied in two elaborate memoirs which were published in the Transactions of the Royal Society in 1866 and 1867, for the second of which a special honorable distinction was conferred upon him by that Society.
7. At about the period of the appointment of the Government Committee, Messrs. Prentice of Stowmarket entered into arrangements with the proprietors, in this country, of Patents for the manufacture of Guncotton according to the Austrian system, and they carried on for a short time the production of the material and its conversion into Mining charges etc. according to the system laid down by Baron von Lenk. It was not long after their works were in operation that a serious accident resulted from the comparatively dangerous nature of some of the manufacturing operations as carried on according to the Austrian System.

8. The results of various experiments instituted by the Government Committee on Guncotton upon the application of this material to military purposes showed:
- (1) that Guncotton as made and used by the Austrians could not be employed with safety in Small Arms and Ordnance;
 - (2) that it possessed some decided advantages over Gunpowder in blasting operations, provided special precautions were attended to;
 - (3) that in order to employ it in land-mining or submarine operations with any prospect of advantageous results, it was necessary to confine the material in vessels of very considerable strength for the purpose of developing its explosive force.
9. The uncertainty of success in its employment for lands-mining operations was illustrated even before the appointment of this Committee in the course of operations of demolition carried on at Corfu, in which Guncotton supplied by the Austrian Government in strong packages specially constructed for the purpose, failed to furnish satisfactory results.
10. Mr. Abel's investigations into the causes which gave rise to an occasional tendency to decomposition in Guncotton manufactured according to the Austrian System, demonstrated that these consisted in the retention of impurities within the long fibres of the Guncotton, even after the material was subjected for several weeks to the most searching purification.
11. To set aside this defect in the Guncotton made according to the Austrian plan and also to obtain greater control over the explosive power of this substance than was afforded by von Lerk's method of manufacture, Mr. Abel devised in 1865 a new system of manufacture which consisted in reducing the Guncotton to the form of a very fine pulp, and in converting the finely divided Guncotton or Pulp into solid highly compressed masses or into sheets or grains.
12. The principal advantages presented by Mr. Abel's system of manufacture over that worked out in Austria are shown in the following comparative statement.

<u>Austrian Process</u>	<u>Abel's Process</u>
Long staple cotton of the best quality has to be employed	Ordinary Cotton Waste (such as is used for cleaning machinery) is used.
The process of manufacture occupied at least <u>four</u> weeks.	The process of manufacture from the raw material to the finished compressed guncotton, occupies <u>four days</u> .
Even after the most elaborate purification the finished Guncotton still retains impurities locked up in the fibres, the purification being chiefly superficial.	The fibre is reduced to minute particles which cannot retain enclosed impurities and the process of purification is of a most searching character.

/m The

Austrian Process

The finished Guncotton may therefore still be liable to be acted upon, in time, by these impurities and to undergo a change.

The operations of converting the guncotton into the forms in which it was used for mining and other purposes, had to be performed with the dry material, and were highly dangerous.

The finished Guncotton is bulky, its equivalent in Gunpowder occupying at least the same space as the latter.

If by any accident a store of this Guncotton becomes ignited it explodes with violence, as the material is in a loose and porous condition and therefore very rapidly inflammable.

In order to employ this material as a mining or blasting agent, or in Torpedoes, it is necessary to confine it very strongly.

Abel's Process

The finished Guncotton is perfectly stable, even when exposed to tropical temperature.

The whole of the manufacturing operations are absolutely safe, the guncotton being wet throughout all the processes, and therefore quite unflammable. The drying of the finished material is the final operation and may be postponed for any time, the compressed guncotton being stored in the damp unflammable state.

The finished Guncotton has a density or compactness nearly equal to that of Gunpowder, and the equivalent of the latter occupies therefore considerably less space.

If compressed guncotton is inflamed even when enclosed in packing cases, it does not explode, but simply burns rapidly. (Many instances of its great safety in actual practice are on record.)

The compressed Guncotton may be made to exert its full destructive force without being confined at all, and when used in Torpedoes it is only necessary to have these of sufficient strength to enable to resist water pressure.*

*The last specified advantage of Guncotton made according to Mr. Abel's system, was first demonstrated by Mr. Brown, Assistant Chemist to the War Department.

13. In April 1865, Mr. Abel took out a Patent for his system of manufacturing Guncotton.
14. Between 1865 and 1868 (when the Guncotton Committee was dissolved), Mr. Abel carried on experiments at the request of that Committee with the view of applying his Guncotton as a material for cartridges for cannon and small arms, and the results arrived at by him (which are appended to the printed Report of the Guncotton Committee presented in May 1868), were of so promising a nature that the Committee in their report "recommended that the method proposed by Mr. Abel for forming cartridges for cannon and small arms, which consists in reducing the Guncotton to pulp and then compressing it into masses of cylindrical or other form, be further prosecuted".
15. The Committee on Floating Obstructions made numerous experiments from 1865-68, with Guncotton manufactured according to Mr. Abel's system; and in their final Report (pages XVI and XVII) they point out the advantages which it presents over the Austrian Guncotton and guided by these, they recommended "that Guncotton be employed as the explosive agent in Torpedoes".

/16.

16. This recommendation was made (as shown in a footnote, page XVII) before it was known that Torpedoes cases need not be made of great strength if compressed guncotton be employed as the explosive agent.
17. The recent Reports of the Royal Engineers Committee and the Torpedo Committee, recommending the adoption of Guncotton, are solely based upon the results obtained with Guncotton made according to Mr. Abel's system, the manufacture of Austrian Guncotton having been abandoned, before the question of the employment of Guncotton in Engineering operations was specially referred to the Royal Engineer Committee for investigation.
18. In devoting his energies unceasingly to the development of the successful manufacture and application of Guncotton, Mr. Abel not only received but scanty encouragement at the hands of the War Office authorities, but also had to contend continually against very strong prejudices entertained by many of those with whom he has been officially associated.

The scientific and practical importance of his labours have however been fully appreciated by the Scientific world, and the attention of several foreign Governments has been attracted, within the last two years, by the results obtained in this country with the compressed material introduced by Mr. Abel.

19. Baron von Ebner, late Director of the Imperial Engineer Committee in Vienna, and who devoted much attention to the application of von Lenk's Guncotton to mining purposes, visited England in 1867 with the object of examining into the new system of manufacture, and, at his instigation, an Engineer Officer was sent to this country this year for the purpose of acquiring detailed information regarding the manufacture and application of compressed Guncotton.
20. The manufacture and employment of Guncotton according to the new system was made the subject of Reports to their Governments by the Professional Attaches of the French Embassy.

Experiments were instituted by the Government Torpedo Committee at Toulon in 1869, and in the beginning of this year, two Colonels of the Marine Artillery were sent to England for the purpose of obtaining information from Mr. Abel on the manufacture and application of this material.

Steps were taken at the outset of the present War, to apply compressed Guncotton extensively to the destruction of submerged rocks on the coast of France.

21. Officers of the Swedish and Danish Navies have visited England with the object of acquiring information about Guncotton, and, quite recently Lieut. Eckermann of the Swedish Navy was directed to apply to Mr. Abel, and since his return, arrangements have been made by that country for extensive experiments.
22. Captain Schulzakenka of the Russian Engineers was sent to England this autumn to study the subject of manufacture etc. of Guncotton, and the Director General of Engineers von Todleben, wrote specially to Mr. Abel requesting him to give all information in his power.

/23.

23. These various officers were all officially referred to Mr. Abel, and instructions were given to the latter to allow Captain Schulzatsakenka to work in his Laboratory.

He has, as a matter of duty furnished the information which he was desired to give.

24. The foregoing statements show that the important improvements in the application of Guncotton which Mr. Abel has developed are appreciated by other countries.

25. In 1867 Messrs. Prentice of Stowmarket, who had perseveringly endeavoured to overcome the practical difficulties connected with the manufacture on a considerable scale, of the Austrian Guncotton, applied to Mr. Abel for permission to experiment upon his system of manufacture, and in 1868, Mr. Abel acceded to their application to work his process under license, with the stipulated agreement that H.M. Government would have full use of his patent without any drawback whatever.

Under this Agreement, no Royalty has been paid by Messrs. Prentice & Co. to Mr. Abel for supplies of compressed Guncotton to Government made from time to time.

Messrs. Prentice as being the only people possessing the necessary enterprise and confidence to enter upon the manufacture of Guncotton, at a time when a very general prejudice existed against this material insisted upon the natural and reasonable stipulation of an exclusive license; hence, as there exists at present no other satisfactory process for the manufacture of Guncotton than that developed by Mr. Abel, Messrs. Prentice are the sole manufacturers of this material.

The period having arrived when H.M. Government has become alive to the special value of Guncotton, as the explosive agent for Torpedoes and Military Engineering purposes, the Secretary of State for War is in a position to establish a Factory for the production of the material, according to the system elaborated by the War Department Chemist, with the power of availing himself to the fullest extent of the special knowledge and experience which have resulted from that gentleman's labours in connection with this material for the last seven years.

Moreover, supplies, in addition to such as will eventually be obtained from the Government Factory, can be drawn from the manufacturers of this material without payment of any Royalty to the Inventor of the process for producing it.

It need scarcely be stated that in a manufacture involving great niceties for the proper fulfilment of chemical operations, those who first carry out such a manufacture upon a considerable scale have to overcome many difficulties, involving money outlay and such expenditure of time.

The manufacture of Guncotton by a few hundred pounds at a time, as carried on by Mr. Abel at Waltham Abbey and Woolwich affords but very slight foundation upon which to start a manufacture at the rate of several tons weekly.

Unless full access be had to the works of the sole present manufacturers of compressed Guncotton, who have worked the thing out practically to its present state of perfection, those entrusted with the establishment of a Government Factory will have to go over the ground which has been travelled over by Messrs. Prentice at their private cost, and, even with the fullest co-operation of Mr. Abel, many months must, in that case, elapse before the manufacture of Guncotton is properly developed at Waltham Abbey.

/If

If, on the other hand, Messrs. Prentice are willing to give the Government the full benefit of the practical experience acquired by them up to the present time, the Waltham Abbey Works will, with the aid of Mr. Abel's special knowledge of these subjects, start at once upon at least as good a working basis as that of the Stowmarket Works at present.

Messrs. Prentice have offered upon certain conditions not only to give full details regarding their manufactory to the Superintendent of the Government Works, but also to give him the benefit of substantial improvements, to which they see their way for adoption in any extension of their Factory.

The offer made by Messrs. Prentice in the first instance to Colonel Younghusband and afterwards officially by letter, with respect to the supply of compressed Guncotton to Government, is to the effect that an order for 200 tons, at the rate of two shillings per pound, would enable them to incur the outlay necessary for a sufficient extension of their works to compass the delivery of Guncotton at a rate of five tons weekly.

Two shillings per pound, delivered free of cost, is the price at which Messrs. Prentice have hitherto executed orders for compressed Guncotton.

In order to compare this cost with that at which it may be expected to manufacture compressed Guncotton at Waltham Abbey, the following approximate estimate is submitted.

	s. d.
1 lb. cotton	4.50
3 lb. Nitric Acid at 6d.	1. 6.00
9 lb. Sulphuric Acid	6.75
	<u>0. 2. 5.25</u>
Deduct value of waste acid to be sold at the rate of eight pounds at $\frac{1}{2}$ d.	<u>4</u>
For 1.6 lb of Guncotton	<u>0. 2. 1.25</u>
Materials for 1 lb Guncotton	1. $\frac{3}{4}$
Wages per lb.	3
Coals and Sundries	<u>1$\frac{1}{4}$</u>
Guncotton per lb.	<u>1. 8</u>

To this must be added the charges for Interest on plant maintenance and superintendence.

It is probable that with the improvements in detail of manufacture which may be expected to be made, the cost, as above estimated, will be reduced in time, but in the present state of the manufacture the cost cannot be fairly taken at a lower estimate.

/It

It appears from the above that Messrs. Prentice's proposed charge would leave a margin of about 4d per lb. from which they must cover cost of carriage, and the outlay to be incurred in more than doubling their existing Works, which only suffices to meet private demands.

In addition to the supply of 200 tons of Guncotton at two shillings per pound, Government would receive from Messrs. Prentice practical information and assistance indispensable to the expeditious establishment of the Waltham Abbey Factory upon a satisfactory working basis.

(Signed) F.A. Abel

November 18th, 1870