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THE MAKING OF GUNPOWDER - F. L. NATHAN.

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WALTHAM ABBEY, ESSEX.

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historian of the period asserts¹ that chalk from the quarries at Stifford was carried by farmers as much as thirty miles inland 'for manuring their lands.'

All the chalk used as manure in Essex was not, however, quarried in the county. Defoe, writing in 1722 of the pits near Gravesend, on the south bank of the Thames, says :²

From these chalky cliffs on the river side, the rubbish of the chalk which crumbles away when they dig the larger chalk for lime . . . is fetch'd away by lighters and hoys and carried to all the ports and creeks in the opposite county of Essex, . . . and sold there to the country farmers to lay upon their land, and that in prodigious quantities ; and so is it valued by the farmers . . . that they not only give from two shillings and six pence to four shillings a load for it, according to the distance the place is from the said chalk cliffs, but they fetch it by land-carriage ten miles, nay fifteen miles, up into the country.

This is the practice in all the creeks and rivers in Essex, even to Malden, Colchester, the Naze, and into Harwich harbour up to Manningtree and to Ipswich. . . . Thus the barren soil of Kent (for such the chalky grounds are esteem'd) make the Essex lands rich and fruitful and the mixture of earth forms a composition which, out of two barren extremes, makes one prolific medium.

A later writer adds³ that,

In Rochford and Dengy Hundreds, the Kentish chalk is generally preferred, as it dissolves and mellows the land better than the chalk from these parts.

At the same period, Kentish chalk was brought by water, in large quantities, to Maldon, Tollesbury, Wigborough, Mersea, and elsewhere, for use in the eastern and north-eastern portions of the county. Much of that landed at Maldon was sent inland by the Chelmer and Blackwater Canal ; but Young tells⁴ how, in 1784, chalk was carried from Maldon to Braxted (a distance of six miles) by means of large five-horse waggons, which made two journeys in the day—'the severest work I ever heard of.' Towards the close of the eighteenth century, chalk seems to have been less frequently used for manure ; for, although Young says⁵ it 'has been largely used in Essex from time immemorial,' he adds that he 'found it carried in the Hundreds near forty years ago in much larger quantities than at present,' when (he explains), much of the land having been chalked, less was required.

Though the old practice of systematically 'chalking' Essex land has been discontinued, the older industry of lime-burning still flourishes. It is carried on extensively at Grays by the Grays Chalk Quarries Company Limited, as well as by

firms or individuals at Saffron Walden, Great Chesterford, Heybridge, and elsewhere.

Within the last thirty years, a large and increasing proportion of the chalk quarried in Essex, especially at the Thurrocks, has been used for making Portland cement, as noticed elsewhere.⁶

An industry closely allied to the foregoing is the MANUFACTURE OF WHITING, which has been carried on at several places in Essex for at least a century and shows no sign of extinction.

In 1840, there were two whiting manufacturers at Colchester (John Blomfield, of the Hythe, and Joseph Willett, of Greensted), two at Maldon (William Baxter and Isaac King), one at Springfield (George Hayward), and others elsewhere.⁷ At the present day, the industry appears to have died out at Colchester, though it is carried on still at Maldon and Springfield. Moreover, new makers have sprung up at Grays (the Grays Chalk Quarries Company Ltd.), Saffron Walden, Wickham St. Paul, Manuden, and Great Henny.

The MAKING OF GUNPOWDER (an intimate mechanical mixture of saltpetre, charcoal, and sulphur) was probably first introduced into England early in the fourteenth century, but its manufacture cannot be said to have been regularly established here until the reign of Elizabeth. The earliest English powder-mill of any consequence was, without doubt (notwithstanding statements sometimes made to the contrary), that situated in the valley of the River Lea, in the south-west corner of Essex.⁸

The lands on which the factory stands belonged originally to the abbots of Waltham.⁹ With the exception of Quinton Hill, the land occupied is low-lying, thickly covered with trees (principally willow and alder planted to furnish charcoal for gunpowder), and intersected by tributaries of the Lea and by artificial canals, over which the materials are transported from process to process. The finished explosives are sent by barges down the Lea into the Thames and so to the magazines at Woolwich and Purfleet.

The earliest known record relating to the Waltham Abbey Powder-Mills bears date 2 March 1560-1. It is of interest as showing

¹ See *post*, p. 492.

² See *Pigot's Directory*, 1840, pp. 108, 132, 98.

³ The still-existing private powder-mill at Chilworth, in Surrey, was established in 1570 : that at Faversham, in Kent (which was a royal factory), about the same time. A large amount of interesting, but wholly undigested, information relating to the Waltham Abbey Factory is to be found in the *Centenary Memorial of the Royal Gunpowder Factory, Waltham Abbey, compiled from Original Sources*, by W. Winters (Waltham Abbey, 1887).

⁴ See Farmer, *Hist. of Waltham* (1735), p. 80 ; also Morant, *Hist. of Essex*, i, 42.

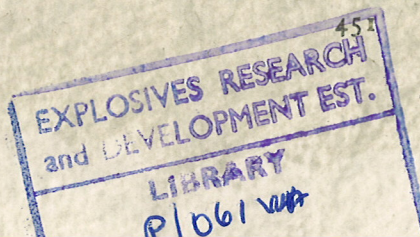
¹ 'Gentleman,' *op. cit.* iv (1771), pp. 340 & 364.

² *Tour i* (1724), letter 2, pp. 10-11.

³ 'Gentleman,' *op. cit.* iv (1771), p. 364.

⁴ *Gen. View* (1807), ii, 204.

⁵ *Ibid.* ii. p. 203.



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that, even thus early, the factory was of considerable extent and was engaged in producing gunpowder for the English Government. On the date named, one Marco Antonio Erizzo, an Italian, writes¹ to John Thomworth (or Tamworth), at Waltham Abbey, in reference to a tender he had made² to supply the Government with materials for making powder. Thomworth was the executor of the widow of Sir Anthony Denny (who had died in 1549), and was probably the owner or manager of the powder-mill.³ The tender in question was referred for consideration to William Bromfield, Master of the Ordnance, who advised⁴ that Neapolitan saltpetre at £3 10s. per cwt. was 10s. per cwt. too dear, and that the offer of 2,000 cwt. of Italian brimstone should be 'respyted,' as there were 'in store at this present [?at Waltham Abbey] 120,000 'weight, whiche wyll make foure hundrythe lasts of corne powder and wyll not be wrought yet into powder this fowre yeres.' Ultimately, large quantities of powder-making materials were purchased from Erizzo, to the value of over £6,000, including Italian brimstone at 18s. per cwt. and Neapolitan saltpetre at £3 5s. per cwt.; all to be delivered in England.⁵ From that day, at any rate (and, doubtless, even earlier), the manufacture of gunpowder on a large scale has been carried on continuously at Waltham Abbey.

In his notice of the manufactures of Essex, Fuller (who became perpetual curate of Waltham Abbey about 1648) says⁶ that

More [gunpowder] is made by mills of late erected on the River Ley, betwixt Waltham and London, then in all England besides. . . . It is questionable whether the making of gun-powder be more profitable or more dangerous; the mills in my parish having been *five* times blown up within *seven* years, but (blessed be God!) without the loss of any one man's life.

The first deaths from an explosion at the powder mills are recorded in the register of burials of the parish of Waltham Holy-Cross, under date October 1665:—'Tho. Gutridg, killed with a powdermill, ye 4 day: Edward Simons, carpenter, so killed, ye 5 day.'

¹ S.P. Foreign Eliz. xxiv, 1.

² S. P. Dom. Eliz. xvi, 33-4.

³ In 1563, he was described (see Harl. MS. 80, fol. 24: printed in Winstone's *Epping and Ongar Highway Trust*, 1891, p. 291) as 'John Tamworth, of London, Esquier, one of the Chief Gromes of the Quenes hignes Pryuye Chamber.' On 12 May in the year named, the Queen or the Duchy of Lancaster granted him for 31 years after next Michaelmas 'all the usual and fallable woods and underwoods' in Wintry Wood, in Waltham, which belonged formerly to the Abbey, for a yearly rent of 40s. On 19 May 1565, he sold the same rights to John Searle, yeoman, of Epping, for £300 for the remainder of his term.

⁴ S.P. Dom. Eliz. xvi, 35.

⁵ *Ibid.* 36-7.

⁶ *Worthies of England* (1662), pp. 318-19.

At this period, one Ralph Hudson, gentleman, appears to have owned the powder-mill, and it is recorded among the manor rolls that, at a Court Baron held on 27 May 1672, the jury presented:

that Ralph Hudson has erected a powder mill near a certain bridge called Hook's Marsh Bridge, upon land pertaining to the inhabitants of Upshire and Hallefield, to the great nuisance of the inhabitants there, and of all others passing by the footway leading by the said mill and the barges lying & there constantly being and to the great danger of the inhabitants and of their cattle daily passing the said mill, and has obstructed the way leading from Hook's Marsh to Edmonsee, to the great danger of the inhabitants, they being deprived of the accustomed way. Therefore, it is ordered that the said Ralph Hudson, without delay, shall remove the said mill and restore the said way, under penalty of forfeiting to the Lady of the Manor, for every week the same shall continue, £5.

Hudson seems to have proved obdurate; for, at a Court Baron held a year later, on 29 May 1673, the jury presented:

that Ralph Hudson, gent., will not remove his powder mill, which is a great nuisance to the inhabitants and to travellers there passing, according to the order of the last Court. Therefore he is amerced at £40.

Also, they present that Ralph Hudson, gent., in shutting up the water, has done so to the nuisance of the footway leading by Norne Marsh to Cheshunt; and it is ordered by the Court that the aforesaid Ralph Hudson shall sufficiently repair the same before the first day of June next, under pain of forfeiting to the Lady of the Manor £5.

Also, they present that the aforesaid Ralph Hudson has done great harm to the Marsh called Norne Marsh and to the hoppet called Norne Marsh Hoppet by cutting the turf for the mending of his banks; and it is ordered that he shall not do the same under pain of forfeiting to the Lady of the Manor, for every time so offending, £5.

In November 1720, there was another fatal explosion, and the following entry appears in the parish register: 'Peter Bennet, of ye town, killed at ye powder mills, ye 27 day.'

Farmer, in his *History of Waltham*, gives a view (Fig. 14) of the factory as it was in 1735. From this view, it appears that there were then some twenty different buildings, as named thereon. Of the factory, Farmer says:⁷

Near the Town, on one of these Rivers [*i.e.* on one of the branches of the Lea], are curious Gunpowder-Mills, which supply the nation with great quantities of gunpowder, being esteemed the largest and completest Works in Great Britain, and are now the Property of Mr. John Walton, a gentleman of known honour and integrity.

This John Walton was (according to Winters⁸) a relative of Izaak Walton, the angler. On

⁷ *Op. cit.* 2-3.

⁸ *Centenary Memorial*, pp. 18 and 21.

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20 October 1675, in the Abbey Church at Waltham, he married Lydia Freeman, and became afterwards 'a gentleman of considerable substance and influence in the town.'

On 3 December 1765, there was another serious explosion, two mills being blown up, but fortunately no one was hurt.¹

In 1770, an Essex historian wrote² of the factory as

several curious gunpowder mills, upon a new construction, worked by water (the old ones having been worked by horses).³ They are reckoned the most complete in England, and will make near one hundred barrels weekly for Government service, each barrel containing one hundredweight. They are now the property of Bouchier Walton, Esqre.

Horse-power was used, however, to some extent, as will be seen, at a considerably later period.

In 1787, the factory was acquired by the Government from another member of the family, a later John Walton.⁴ From that time to the present, it has always been known as the Royal Gunpowder Factory. The surrounding lands were not finally purchased till 1795.

Upon becoming Crown property, the factory was enlarged by the Board of Ordnance, under whose management it fell. Some fourteen or fifteen of the old hands were retained and workmen were brought also from the King's Powder-Mill at Faversham, both the Faversham and Waltham Abbey Factories being worked under the superintendence of Major (afterwards Sir William) Congreve, Deputy-Comptroller of the Royal Laboratory at Woolwich. Forty-six hands were employed in October 1787, at which date stone runners and beds, such as are still employed, were in use for the process of 'incorporating' (i.e. mixing).

In 1791, the factory records speak of double horse-mills being in use; and, in 1795, powder appears to have been sent regularly from Waltham Abbey to Purfleet, for proof. Sometimes it went overland in ammunition waggons: at other times, by water in barges.⁵

Small explosions seem to have been not uncommon at this period⁶; but, as a rule, they did no serious injury. In 1801, however, a horse 'corning-house' (i.e. a building in which cakes of gunpowder are broken into grains) exploded, killing nine men and four horses. In consequence of this explosion, a committee of the

Royal Society visited the works to examine and report on the possibility of danger arising from electrical excitation, caused by walking or rolling barrels on the leather-covered floors, or by the use of silk-covered 'dusting reels,' in which the fine dust is removed from the grain powder. The committee reported, however, that there could be no danger from such causes.

The introduction into the manufacture of gunpowder of charcoal burnt in retorts or 'cylinders,' instead of in 'pits,' occurred about this time. In 1804 and for some years afterwards, government cylinder works, in connexion with the Waltham Abbey Factory, were maintained at Fisher Street and at Fernhurst, in Sussex.⁷ In the same year occurs the first mention of iron runners and beds for incorporating mills. The annual yield of the factory at this period was about 20,000 barrels, probably of 90 lb. each.

In 1805, the Board of Ordnance purchased the Cheshunt corn-mill, and in 1809 the Waltham Abbey corn-mill, for the sake of their water-power rights.

In 1811, in order to show that the manufacture of gunpowder could be carried on more economically at the Royal Gunpowder Factories at Waltham Abbey and Faversham than by private merchants, General (afterwards Sir Wm.) Congreve addressed a statement on the subject, dated 20 April 1811, to the Master-General of the Ordnance.⁸ This statement showed that the profit, between 1 January 1789 and 31 August 1810, on 407,408 barrels of gunpowder of 100 lb. each, made at Waltham Abbey and Faversham, amounted to £288,357 6s. 0½d.; and that the profit on 'regenerating' 127,419½ barrels, between 1 January 1790 and 31 August 1810, was £53,091 11s. 3d., or a total profit of £341,488 17s. 3¼d. The same statement gives the whole amount expended by the Government on the original purchase, and on new erections, repairs, and improvements, up to 31 December 1799, as £45,683 2s. 7½d.

On the morning of 27 November, 1811, there was another serious explosion, a press-house and a corning-house being blown up and eight men killed. After this, Sir William Congreve substituted Bramah hydraulic presses for the old screw-presses used previously for giving the requisite density to the gunpowder. In October 1814, it was ordered that, for working the machinery, water-power was to be substituted entirely for horse-power.⁹ In 1816, the old

¹ *Ann. Reg.* viii, 149.

² 'Gentleman,' *op. cit.* iv, 147.

³ According to Winters (*op. cit.* 20), the system of working by means of water-power had been introduced as early as 1739.

⁴ A pillar sundial, which belonged to this John Walton and has affixed to it a metal plate engraved with his name, still stands in front of the offices of the factory.

⁵ See Winters, *Centenary Memorial*, pp. 44-5 and 50.

⁶ *Ibid.* 34-5.

⁷ For information as to the steps taken at this time to supply the factory with charcoal, see p. 447.

⁸ *A Statement of Facts relative to the Savings which have arisen from Manufacturing Gunpowder at the Royal Powder Mills . . . since the year 1783 (1811).*

⁹ At this time, in all probability, horse-power was finally disused. In 1810, according to Winters (*Centenary Memorial*, pp. 67 and 78), there were in use nine water-mills and seven horse-mills; and, in 1813

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corning-frame was replaced by a new granulating machine, patented by Sir Wm. Congreve.¹ It was erected on that portion of the factory known as the Lower Island.

During the war with France, very large quantities of gunpowder were produced at Waltham Abbey, the figures for the later years being as follows :

Years.	No. of Barrels.
1809	20,050
1810	20,688
1811	21,252
1812	21,000
1813	25,060
1814	10,161
1815	15,790

On the conclusion of peace, the output was much reduced. In 1816, it amounted to about 4,000 barrels only ; in 1819, it had fallen to about 1,000 barrels ; and, in some succeeding years, it was even less. In addition, however, large quantities of old powder were 'regenerated' each year at this period. In 1822, the establishment was fixed at thirty-four persons.²

In 1825, the Royal Factory at Faversham was sold ; and, nine years later, the Royal Factory at Ballincollig, in Ireland, was disposed of also. Waltham Abbey thus became the sole royal gunpowder factory, and has remained so to the present day.

In 1843, there was an explosion, attended with the loss of seven lives, of two corning-houses, a press-house, and a reel-house. Professor Faraday visited the works soon afterwards to report on various matters connected with the safety of the buildings.

At various times between 1803 and 1853, the Board of Ordnance purchased land and buildings adjacent to the factory, both in the town of Waltham Abbey and along the banks of the Lea, to the north of the factory, acquiring altogether about one hundred and forty acres. They purchased also the whole right of water of the River Lea and all its branches, from King's Weir, in

(when the war was at its height), twenty-four water-mills and nine horse-mills. Winters adds (p. 63) that 'The horses had bells on their harness ; and, when they passed round, they struck against a spring which caused the ringing of a small bell, to let the heads of [the] factory . . . know if they performed their work regularly and at the proper speed. These work-bells were to be heard jingling from mill to mill . . .'

¹ Patent no. 3937 of 1815 (3 July).

² In 1813, during the war, it had exceeded 250 hands, and the wages paid to them had amounted to £17,212 (see Winters, *Centenary Memorial*, pp. 75-8). This decrease after the war was sufficient to reduce noticeably the population of the parish (see *Census Report*, 1821, p. 100). At the time of the following census, thirty men were employed (see *Census Report*, 1831, p. 198).

Nazing, to the Black Ditch, in Sewardstone, a length of five miles.³

In 1853, the factory was capable of producing 10,000 barrels of gunpowder and of storing 5,000 tons of saltpetre and sulphur. The value of the buildings, land, and water-rights was estimated at £230,000.⁴

In 1857, Major J. Fraser Baddeley published a full description of the methods of manufacture then followed.⁵

In 1858, Sir W. Snow Harris, F.R.S., after an inspection of the factory, drew up a report for a system of lightning conductors for all the houses in it. They were subsequently installed.

On 1 April 1860, a force of Metropolitan Police was substituted for the 'rounders' and 'watchers' who had looked after the factory by night since the Government acquired it in 1787.⁶

In 1870, the factory contained thirty-two pairs of incorporating-mills, some driven by water and some by steam. These could incorporate annually materials for about 27,580 barrels of large-grain, or 13,690 barrels of fine-grain, gunpowder. The number of men employed was about one hundred and fifty.⁷ All the processes preparatory to the actual manufacture of the powder were carried on in the factory, in order to ensure the absolute purity of the finished article. These processes included the refining of sulphur and saltpetre and the burning of charcoal in cylinders.⁸

For many centuries, black gunpowder was the only explosive. Nothing else was made at the Waltham Abbey Factory until 1872, when the production of guncotton (discovered originally in 1846 by the German chemist Schönbein) was commenced on a manufacturing scale, according to a process worked out at the factory by Sir Frederick Abel.

³ *First Report of the Waltham Abbey Committee, appointed by the Honourable Board of Ordnance, 11 March 1853, upon the effect of the Water Bills now before Parliament on the Ordnance Establishments of Waltham Abbey and Enfield* (1855), p. 12.

⁴ *Op. et loc. cit.*

⁵ *Pamphlet on the Manufacture of Gunpowder, as carried on at the Government Factory, Waltham Abbey, (Waltham Abbey, 1857).*

⁶ Winters says (*Centenary Memorial*, pp. 126-7): 'The watchmen were provided with large overcoats and rattles. These men were stationed at each watch-house or box, and divided the watch into three parts—1st watch, from the time of leaving off work to ten p.m.; 2nd watch, from ten p.m. to two a.m.; 3rd watch, from two a.m. till the workmen came. Each watchman had to strike the various bells on his beat every hour, and was subject to meeting the rounder at any time during his watch. Beds were provided in the watch-houses for two watchmen, who were supposed to sleep while the third did duty.'

⁷ See *A Handbook of the Manufacture and Proof of Gunpowder, as carried on at the Royal Gunpowder Factory Waltham Abbey*, by Capt. F. M. Smith, R.A. (1870), p. 7.

⁸ *Ibid.* p. 10.

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The original guncotton factory consisted mainly of old buildings which had formed part of the saltpetre refinery and abutted on the principal street of the town. It was capable of turning out about two hundred and fifty tons of guncotton per annum. In 1885, one hundred acres of land, known as Quinton Hill, were purchased by the Government and a new guncotton factory, which started work in 1890, was erected there.

The kind of gunpowder known as 'brown' or 'cocoa' powder was introduced from Germany in 1883, and a number of new buildings were erected in the old part of the factory for its production, which was commenced in 1885.

In 1889, Major W. H. Wardell published another very full account of the methods of manufacturing gunpowder at Waltham Abbey.¹

Smokeless powders for military purposes were first produced in France in 1886. In 1890, Sir Frederick Abel's Explosives Committee recommended a smokeless powder, to which the name of 'Cordite' was given, and its manufacture was commenced at Waltham Abbey in 1891. Cordite is a mixture of nitro-glycerine 58 parts, guncotton 37 parts, and mineral jelly 5 parts. For its production, a nitro-glycerine factory was put up on Quinton Hill, where the necessary buildings for making cordite were also erected. Later, to meet the increased demands for cordite, owing to its having taken the place of gunpowder, a second nitro-glycerine factory was built in the old portion of the factory, and this started work in 1898. At the same time, the majority of the houses formerly used for the manufacture of gunpowder were converted into houses for the manufacture of cordite, the original cordite buildings being no longer suitable for the larger output required.

A modified cordite is now being made, in which the quantity of nitro-glycerine has been reduced to 30 parts and the quantity of guncotton increased to 65 parts. This modification entailed considerable additions to the factory and 94½ acres were acquired to the south of Quinton Hill for the erection of the necessary buildings. The guncotton factory was also extended.

At the present time, the factory is capable of producing annually 2,000 tons of cordite, about 200 tons of gunpowder, and about 150 of guncotton for mines, torpedoes, &c. It covers 411¼ acres, and has about five miles of navigable waterways. It comprises three hundred separate buildings, and the average number of hands employed has been, in recent years, between 1,200 and 1,300.

Allusion has been made already to the conveyance of powder (sometimes overland in waggons: sometimes by water in barges) from Waltham Abbey to Purfleet for storage. At this place, which lies on the north bank of the Thames in the Essex parish of West Thurrock, the

Government powder magazine has long been situated. It was erected in pursuance of an Act, passed in 1760,²

for taking down and removing the magazine for gunpowder and all buildings thereunto belonging, situate near Greenwich, in Kent, and erecting instead thereof a new magazine for gunpowder at Purfleet, near the River Thames, in the county of Essex.

In 1771, an Essex historian writing of the place, says: ³

Here is the noble and curious magazine for powder, erected by government. It stands at the western extremity of the parish; is strongly arched; and every way well secured against fire, lightning, &c. A good quay is also erected by the water-side for the landing of the powder; also a handsome house on the hill above for the store-keeper, and barracks for one hundred mattsosses⁴ to guard the magazine.

Even at the present day, all British military stations, both at home and abroad, are supplied from these stores.

BRICK-MAKING and TILE-MAKING have been carried on in Essex from a very early period. This is natural in a county that contains practically no building stone. For the last four centuries, the brick-making industry has been of considerable and increasing importance and is now carried on to a greater extent than ever.

That the Romans made bricks in Essex is proved by the abundance of the very large, thin, square, tile-like bricks found at all places known to have been Roman settlements, and especially at Colchester.

After the time of the Romans, however, it seems clear that bricks were neither made nor used largely for several centuries. Yet the art of making bricks was not lost in England during this long period, as has often been stated, and bricks were used occasionally for building right through the middle ages. We have, however, in the county, no brick-building of this period, so far as I know, with the solitary exception of the thirteenth-century Early-English chapel of St. Nicholas, at Little Coggeshall. This remarkable building has quoins, dressings, and window-mullions of brickwork. The bricks are large and tile-like, about twelve inches long, six inches broad, and vary from one-and-a-half to two inches in depth.

It may be, however, that tiles were used commonly for roofing all through this period. At all events, one Alexander 'Tigulator,' who was a tyler, lived at Colchester in 1301, when his taxable goods were assessed at £17s. 11d. showing that he was a fairly wealthy man.⁵ A century and a quarter later, tile-making must have been an industry of some importance in the

² 33 Geo. II, cap. 11.

³ 'Gentleman,' op. cit, iv, 355.

⁴ Gunners or gunner's mates: an obsolete term.

⁵ *Trans. Essex Arch. Soc.* (new ser.), ix, p. 136.

¹ *Handbook of Gunpowder and Guncotton* (War Office Official Paper, 1888).

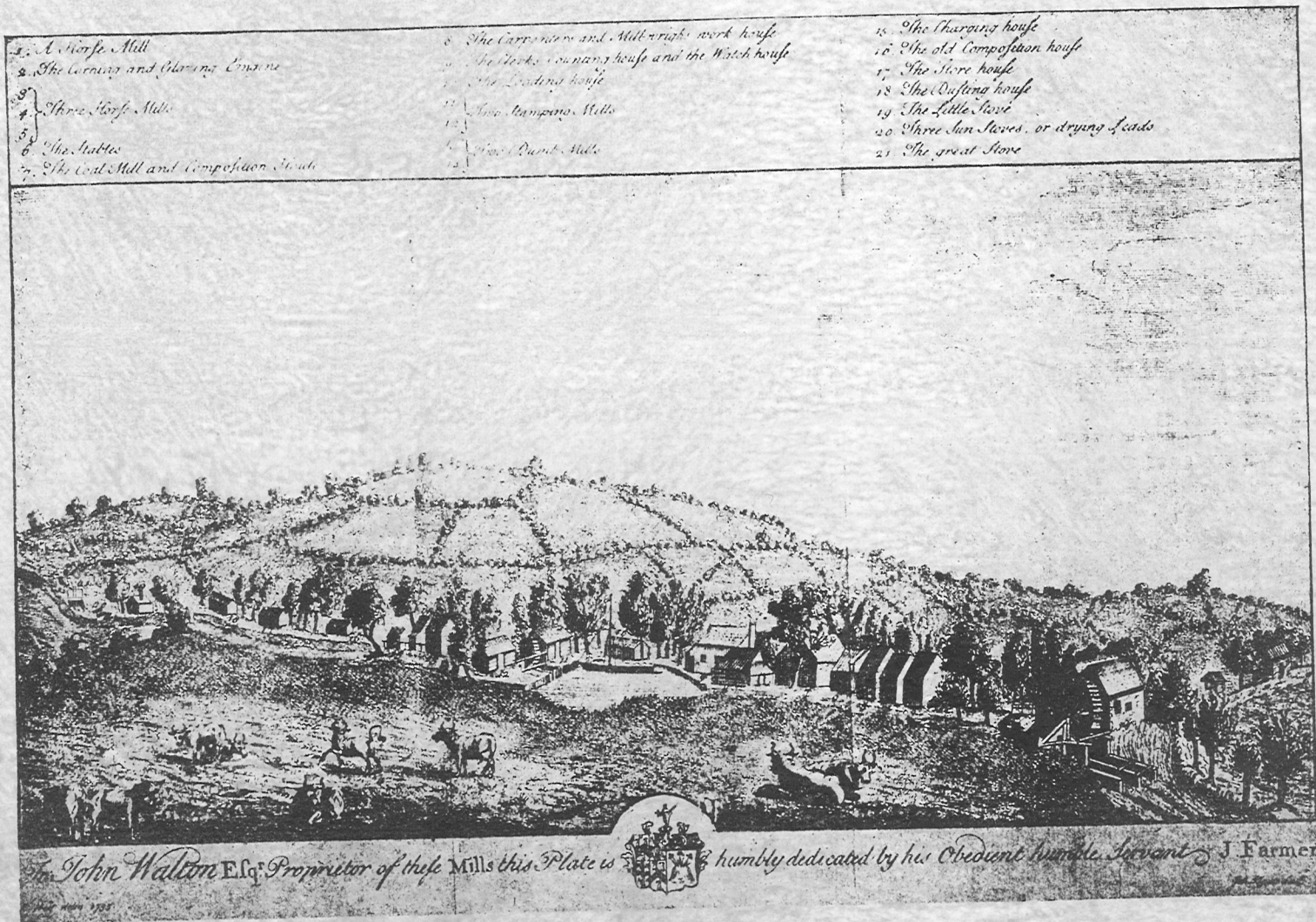


FIG. 14. THE GUNPOWDER FACTORY AT WALTHAM ABBEY IN 1735

(After Farmer)