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Report on the Manufacture of Matches

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are all frequently visited, and once the farmer has reached even as far as Doncaster.

(o) It is pathetic to see an entry, "Musick, 3*d.*," each time Christmas comes round. Otherwise the only signs of merriment are the entries "skittles, 3*d.*" "bako, 2*d.*" (tobacco).

William Bagshaw, the son, married in 1707, Ann Nadin of Alstonfield in Staffordshire. She died shortly after the birth of their only son, Thomas, and the funeral took place at Alstonfield on November 1st, 1707. The following were the funeral expenses :

	£	s.	<i>d.</i>
4 pecks of malt, 2 of flower	0	6	?
11 dozen of bread	0	11	?
2 pound of treacle	0	6	?
2 pound and a half of sheuger (sugar).....	0	1	?
1 pound and a half of reasons	0	0	?
2 ounce of keen (cayenne) peper	0	0	?
1 ounce of clove peper	0	0	?
2 yards and a halfe of flannell	0	2	5
and for a coffin	0	5	10
and for 2 cheeses	0	1	8
and the bishope for burying her	0	1	0
and clarke fees	0	1	3
and the churchwardens fees for grave.....	0	3	?
and for ringers	0	1	0
and gave to neighbours 3 <i>d.</i> a pice which comes to ye sum of	1	1	6
and for a?	0	0	6
	£2	18	1

ALFRED HUGHES

REPORT ON THE MANUFACTURE OF MATCHES¹

THERE were, in 1899, 25 factories in the United Kingdom devoted to the manufacture of matches, and in these 25 factories there were employed in 1897 :—

	Males.	Females.	Totals.
Adults over 18 years	643	2,015	2,658
Young persons under 18 years	425	1,067	1,492
Half-timers (children) under 14 years	2	0	2
	1,070	3,082	4,152

¹ A report prepared at the request of the Fabian Society in reply to a schedule of questions submitted by the International Labour Office.

The whole of these 4,152 persons, however, are not engaged in the manufacture of yellow phosphorus matches.¹ In one case only "safety" matches are made, and in another, the Diamond Company at Liverpool, the matches are made by nearly automatic machinery. This Company employed in 1897-8, 514 persons, of whom 337 were engaged in cutting, dipping, drying and boxing, by machinery. In the other 23 factories, in which yellow phosphorus was used, 3,134 persons were employed, as follows;—

	Mixing, dipping, and drying.	Boxing.	All phosphorus processes.	Non-phosphorus processes.
Male	237	8	245	
Female.....	21	1,255	1,276	
Totals.....	258	1,263	1,521	1,613

There are no workers in match-making working at home in Great Britain; and only in one or two cases are so small numbers as 10 persons employed. Three firms together employed about 2,900 hands; 3 others employed from 700 to 900, leaving in the other 19 factories about 500 employees all told.

Since 1897 the number of factories has decreased, but there has been no diminution in the number of persons employed.

There were, until recently, two sorts of matches generally manufactured in this country. In one case only "safety" matches were manufactured, and these were made with red phosphorus inflammable only on prepared surfaces. The other firms used white or yellow phosphorus. In two or three cases only wax vestas were made, and consequently the paste was attached cold and gave off no fume; in one other case the matches were made by nearly automatic machinery, and were practically not handled by the operatives; and in the other factories they were made with white phosphorus to "strike anywhere."

The proportionate manufacture of these two sorts of matches may be gauged by the fact that whereas 60 tons of white phosphorus are used annually, only 3½ tons of red are used in the manufacture of matches.

In January 1901 there were 24 match factories in Great Britain, and

In 15 cases yellow phosphorus was used;

In 3 cases the use of yellow phosphorus has been discontinued;

In 1 case the factory was not yet working;

In 3 cases the factory had been closed during the past 12 months.

There are no matches made of sesquisulphid of phosphorus in this country. The composition of the usual white phosphorus

¹ *i.e.*, Matches which have dangers to health attendant on their manufacture.

“strike anywhere” match is a paste of glue, phosphorus, chlorate of potass, powdered glass, sometimes magnesia or lime, coloured by a magenta dye. The percentage of white phosphorus is usually about 5; sometimes as much as 10 per cent. is used, but not often. The amount of chlorate of potass is not mentioned by authorities, and it is apparently not considered of hygienic importance.

In the case of the three firms where the use of yellow phosphorus has been discontinued, the composition of the match paste is not stated and is apparently regarded as a trade secret.

Match factories are regulated according to the Factory and Workshop Act, 1901, and the administration of this law is vested in the Home Secretary acting through Factory Inspectors. The special rules relating to the industry are given in the appendix to *The Law relating to Factories and Workshops*, by Abraham and Davies, 1902. It is not necessary to get a special license for manufacturing matches, but the plans of every new factory proposed to be erected, or old factory proposed to be structurally altered, or place proposed to be used, for the purpose of carrying on any phosphorus process, must be deposited in duplicate with the Chief Inspector of Factories, who must certify in writing his approval of the plans before the work can be proceeded with. Neglect to disapprove within a period of six weeks may be taken as approval.

Turpentine is said to have been tried in one or two places as a means of keeping the fumes from the dipper's face, but its use was abandoned without a long trial, from what reason is not stated.

The manufacturers of matches have recently done something on their own initiative towards improving the sanitary conditions of their factories. Three years ago Drs. Thorpe and Oliver reported to the Home Secretary that the lavatory arrangements in match factories are generally inadequate, the exception being in the case of the Diamond Co. at Liverpool. Since their report appeared, a great improvement has taken place, and the special rules now make definite provision for sufficient lavatory accommodation.

Mechanical ventilators are now also provided in accordance with the special rules. They undoubtedly render good service.

The protective measures are much appreciated by the workers, but it was found necessary to impose a penalty on both employers and workpeople in cases of proved neglect. There are few cases of proved neglect under the rule.

Medical opinion is undecided whether the chief danger arises from the fumes given off, or from the phosphorus coming into contact with the worker's person. Cases of phosphorus necrosis have arisen through both causes. An analysis of the fumes arising from the dipping slab shows according to three experiments :—

	I.	II.	III.
Phosphoric oxide (P ₄ O ₁₀)	71.0	70.1	78.2
Phosphoric oxide (P ₄ O ₆)	9.6	3.2	4.7
Phosphorus	19.3	26.6	17.0

The oxides of phosphorus, therefore, prevail in the fumes to the extent of about 80 per cent. Dr. Oliver seems to incline to the opinion that it is from the fumes the chief danger arises. He says, "In the case of the match-maker . . . had it not been for exposure to the fume of phosphorus . . . the workman would not have become the victim of phossy jaw." (*Dangerous Trades*, p. 16), and he points out that "since the introduction of fans on the far side of the (dipping) slab (blowing the fumes away from the worker), the occupation of dipping in match works has become much less dangerous . . ." (*Ibid.* p. 420).

In the 21 years from 1880 to 1900 inclusive, there have been 105 cases of phosphorus poisoning recorded, and of these 19 have terminated fatally. At Bryant and May's factory there were 51 cases, 9 fatal, in 20 years, and 31 females, 20 males suffered. The males were mostly dippers and suffered by reason of the fumes, but the females were engaged in boxing, chiefly, where either handling, or the fumes in the room (not so poisonous by reason of chemical decomposition as the fumes arising from the dippers' slabs), may have been the cause of illness.

The best results, from the workers' point of view, have been obtained in the manufacture of "safety" matches, *i.e.* those composed of red phosphorus, striking only on prepared surfaces. With wax vestas, the results also show comparative immunity from poisoning, because the stems are "dipped into cold paste." In the manufacture of ordinary "strike anywhere" matches, the best results have been obtained at the Diamond Match Company's manufactory, Liverpool. There the matches are made by elaborate machinery, nearly automatic, the material being put into the machine at one end and the matches coming out complete and boxed in 1 hr. 20 min. at the other end. Messrs. Bryant and May, another large firm, now use another substance, about which the managing director wrote in 1901 to Dr. Oliver: "We are well satisfied with our long trial of the new composition. There has not been and there cannot be, from the nature of the composition, any sickness among the workpeople . . . We have not used an ounce of yellow phosphorus for nearly ten months" . . . Other smaller manufacturers have also undertaken to produce "strike anywhere" matches from non-poisonous substances (*Dangerous Trades*, p. 429).

By abstention from using it, it has therefore been recently shown to be possible to avoid the dangers of white phosphorus. Where it continues in use it is not possible to absolutely avoid poisoning, three cases being reported in 1900, and four in 1901; but the number suffer-

ing is now a very small percentage. The declension may be seen in the following cases of poisoning reported :

In 1898	there were	21
„ 1899	„	8
„ 1900	„	3
„ 1901	„	4

The dangers therefore still exist, but in a greatly modified degree.

The prohibition of the use of white phosphorus in this country is not desirable at present, unless by international arrangement. Great Britain has a large export trade, especially to tropical climates, and the “safety” (red phosphorus) matches now manufactured are said to deteriorate in the tropics through climatic influences. If, however, the compound used by Messrs. Bryant and May can withstand this tropical heat without deterioration it would be desirable to make the use of white phosphorus illegal. In such a case the composition of these matches would have to be made known, and no infringement of patent be implied in its use by other manufacturers.

The consuming public would oppose the unconditional prohibition, as the demand is for a “strike anywhere” match. Attempts have been made to educate public opinion to demand only “safety” matches, but without much success.

The restrictions in the “special rules” regulating the trade would seem to be an inducement to manufactures to endeavour to produce a “strike anywhere” match composed of a non-poisonous substance, as it is since the promulgation of these rules that success has been obtained.

State monopolisation of the manufacture of matches would be desirable in the end, but at present it is not feasible. The danger attaching to their manufacture can be removed in other ways, and the industry placed on a level, as regards safety, with other industries. The State could, however, do good in another way. In all State works and offices the use of matches made from white phosphorus should be prohibited, and “safety” (red phosphorus) matches or “strike anywhere” matches made without white phosphorus should be provided instead. State monopolisation of the sale of matches is scarcely feasible or desirable. Firm control of the industry, enforcing rigid obedience of special rules, is what promises to be most effective.

GEORGE H. WOOD

Authorities.

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