THE EXAMINATION OF COTTON, COIR AND ESPARTO-GRASS DUST FOR HISTAMINE

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(With 1 Figure in the Text)

As a result of some preliminary investigations upon the aetiology of an asthmatic type of disability among workers in carding-rooms of cotton mills, Maitland, Heap and Macdonald (1932) showed that it was possible to extract from some samples of cotton dust a substance which gave the biological reactions of histamine. The dust was that to which affected workers would be exposed. The amount of histamine recovered varied from 0·02 mg. to less than 0·004 mg. per g. of dust. Different bulk samples of dust contained unequal amounts, and the amount also varied in different fractions of one sample graded according to the size of dust particles. It was thought that the finer fractions contained the larger amounts of histamine and that some bulk samples were, relatively at any rate, histamine free.

Two samples of dust (Nos. 17 and 18) have since been examined; they contained histamine in possibly significant quantities. Dust No. 17 came from the Shirley cage in a mill spinning a mixture of American (Texas) and Argentine cotton; sample No. 18 was extracted by a Shirley cage from a mill also spinning American and Argentine cotton and was the very fine dust that had escaped through the gauze of the dust filter.

These samples were fractionated according to the size of dust particles by standard 50, 100 and 200-mesh sieves of the Institution of Mining and Metallurgy. In addition for sample No. 17 a 300-mesh sieve was used; the dust of sample No. 18 which passed the 200-mesh sieve was further graded by the method of air flotation. The sieve apertures were: 50 mesh, 0·254 mm.; 100 mesh, 0·127 mm.; 200 mesh, 0·063 mm.; 300 mesh, 0·049 mm. The following fractions were obtained:

Sample No. 17

17 *a*, too coarse to pass through a 50-mesh sieve.
17 *b*, passed a 50 but not a 100-mesh sieve.
17 *c*, passed a 100 but not a 200-mesh sieve.
17 *d*, passed a 200 but not a 300-mesh sieve.
17 *e*, passed a 300-mesh sieve.

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The cotton fibres from the first three samples were removed as far as possible by air blowing. These fractions had the following moisture and ash content:

Fraction	Moisture content %	Ash content (original sample) %	Ash content (dried sample) %
17 *a*	12·22	18·70	21·3
17 *b*	6·04	56·6	60·2
17 *c*	2·89	79·3	81·7
17 *d*	3·36	75·2	78·0
17 *e*	4·16	70·7	73·8

Sample No. 18

18 *a*, too coarse to pass a 50-mesh sieve.

18 *b*, passed a 50 but not a 100-mesh sieve.

18 *c*, passed a 100 but not a 200-mesh sieve.

18 *d*, 18 *e*, 18 *f*, 18 *g*, fractions of the dust that passed a 200-mesh sieve, in decreasing order of size of particles.

To obtain the last four grades, the finest dust contained in the fraction that passed the 200-mesh sieve was separated by air flotation, the particles removed being caught either in settling towers or in an electrical precipitator; the residue was the fraction 18 *d*. The part that was removed was then refractionated similarly, the residue from it being the sample 18 *e*, that caught in the settling towers being 18 *f*, and the very finest fraction caught by the electrical precipitator being 18 *g*.

The size distribution of particles, apart from fragments of cotton fibre, was as follows:

Mean diameter of particles in μ	80	40	32	24	20	16	12·8	9·6	6·4	3·2	1·6	—
% of particles in 18 *d*	3·5	28	31	12	7·5	5	5	5	2	—	—	—
% of particles in 18 *e*	—	1	8	14	21	24	17	9	5	—	—	—
Mean diameter of particles in μ	>10	10	5	4	3	2·5	2	1·6	1·2	0·8	0·4	0·2
% of particles in 18 *f*	3	3	4	7	6	5	6	9	12	33	11	—
% of particles in 18 *g*	—	1	1	2	3	3	3	8	12	25	42	

The distribution of fragments of cotton fibres in the last four grades was as follows:

Fraction	% of total number of particles	Size range in μ (length)
18 *d*	30	100–20
18 *e*	22	80–20
18 *f*	10	40–4
18 *g*	7	20–4

The moisture and ash content of the fractions of sample No. 18 was as follows:

Fraction	Moisture content %	Ash content (original sample) %	Ash content (dried sample) %
18 *a*	13·19	12·2	14·08
18 *b*	7·86	47·3	51·3
18 *c*	2·52	85·0	87·1
18 *d*	1·60	91·0	92·5
18 *e*	2·85	79·6	82·0
18 *f*	5·98	46·6	49·6
18 *g*	7·54	49·1	53·1

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The various fractions of dust were prepared for assay as follows:

(*a*) By Soxhlet extraction with ether for about 7 hours. This removed most of the fat and should not have removed histamine, but occasionally a depressor reaction was given by the ether extract—probably because of traces of moisture.

(*b*) By further Soxhlet extraction with absolute alcohol for 24 hours or longer. The alcoholic extract was evaporated on a water bath until it achieved a constant weight. A watery extract of the residue was prepared so that each c.c. was equivalent to 20 or 50 mg. of residue. This solution was tested as soon as possible after it was prepared, and compared with histamine (the ergamine acid phosphate of Messrs Burroughs, Wellcome and Co.).

(*c*) By Soxhlet extraction with water after the ether and alcohol extractions. This usually yielded a coloured but inactive solution.

The alcoholic extract, like histamine, had the following properties. It was a stimulant, in great dilution, to the isolated guinea-pig uterus suspended in a bath of oxygenated Ringer solution. It depressed the blood pressure of the etherised or otherwise deeply anaesthetised cat. It depressed and then raised the blood pressure in the spinal or lightly chloralosed cat. As histamine rapidly loses its activity in dilute neutral or alkaline solution, the solutions were prepared in weak acid on any occasion on which it was inconvenient to assay the depressor substances forthwith, and these solutions were neutralised just before injection. (This depressor-pressor response is due to the combined effects of capillary dilatation and arteriole constriction, the latter being caused primarily by an action on plain muscle and secondarily by stimulation of the secretion of adrenaline. Histamine stimulates most plain muscles and many secreting glands.) The blood pressure effects persisted even when enough atropine had been administered to paralyse the actions of the vagus nerve on the heart, and hence were not due to the choline group. Sometimes other effects characteristic of histamine were noted such as stimulation of intestinal or respiratory movements.

The alcoholic extracts, when compared with histamine solutions of known strengths (Fig. 1), contained as much as 0·01 mg. histamine per c.c., corresponding to a concentration in the dust of 0·01 mg. per g., if one assumes that all the histamine was extracted and that all was preformed. In some extractions about one-tenth of this amount was found. It was found for sample No. 17 that the finest fraction was richest in histamine, but all the fractions contained some. Thus 17 *e* contained about twice as much as 17 *c* and 17 *c* about one and one-half times as much as 17 *a*. The finest fraction of sample No. 18 contained less histamine than the finest (but not similar) fractions of sample No. 17. Thus 18 *g* contained about 0·0004 mg. per g. of dust and 18 *f* about 0·0002 mg. per g.

We have examined in all only a limited number of samples of cotton dust but we believe that histamine is a fairly constant constituent of the dust that is extracted from carding-rooms of cotton mills. It is to be expected that, as we have found, the histamine content of various samples will differ. Our ex-

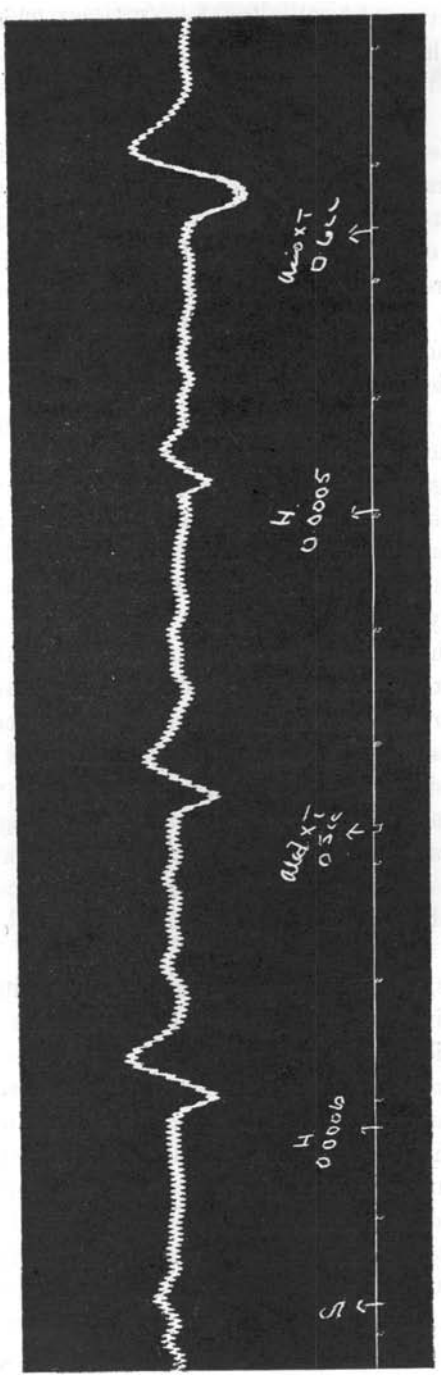

Fig. 1. Cat, ♂, decapitate. 23. iii. 1933. Tracing of effects on blood pressure of alternate injections of acid extract of dust, neutralized just before injection, and histamine. *S* is a control injection of saline. Time in minutes. 1 c.c. of acid extract is to be regarded as the equivalent of 1 g. of dust (fraction 17*c*) It will be seen that 0·6 c.c. extract > 0·0006 mg. histamine > 0·5 c.c. extract. 1 g. of dust presumably contains, therefore, about 0·001 mg. histamine. (Tracing reduced by ⅓.)

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perience so far also indicates, as we suggested previously, that the finer fractions contain larger amounts than the coarser fractions.

We have had the opportunity to examine one sample of dust from coir (Algerian cocoa-nut fibre) and one sample of dust from esparto-grass. The handling of the esparto-grass produced considerable amounts of a fine black dust. This grass was used for stuffing upholstery. Each sample of dust was extracted and tested as has been described. The alcoholic extracts contained only traces of depressor substances, much less than was found in cotton; esparto-grass dust contained even less than coir dust.

CONCLUSION

The possible importance of histamine in cotton dust as a factor in the causation of the respiratory disability from which card-room operatives suffer has not yet been assessed. Histamine does appear however to be present in most samples of dust to which they are exposed and especially in the finer particles which would most readily reach the lungs. It is of some interest and perhaps suggestive that workers exposed to coir dust and esparto-grass dust, both very dusty occupations, do not suffer from the respiratory trouble found among cotton operatives, and that the single samples of these dusts that have been examined were practically free from histamine.

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REFERENCE

MAITLAND, H. B., HEAP, H. and MACDONALD, A. D. (1932). *Report of the Departmental Committee on Dust in Card Rooms in the Cotton Industry,* Appendix VI. London: H.M. Stationery Office.

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