AN OUTBREAK OF WEAVER'S COUGH ASSOCIATED WITH TAMARIND SEED POWDER

BY

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Several cases of respiratory disease, varying in severity from a dry cough to severe bronchospasm, have recently occurred in a few British textile factories. They appear to be connected with the use of ground tamarind seed as a sizing agent. Although the seed had been used extensively in India for this purpose, no untoward effects on health had been reported but shortly after its introduction into Great Britain cases began to appear. The worst effects were seen in certain weavers handling rayon but there were some cases also in those concerned with cutting the cotton velvet.

Sizing and Weaving

The application of a size to the warp threads is a necessary preliminary to weaving in order to give the yarn power to withstand the friction in the loom. In the past several substances have been used, usually of a starchy character. Sago, farina, maize, potato starch, and carob flour (locust bean gum) are commonly used materials but research is constantly going on to discover better sizing agents. Improvements in finishing, such as crease resistance, very often depend upon the size used and the ease and completeness of its removal.

About one twentieth of the size applied leaves the warp during weaving. An unknown quantity remains suspended in the atmosphere but most falls on the floor, together with short fibre, forming a fluffy deposit called, in north-east Lancashire, "dawn".

Previous Outbreaks of Weaver's Cough

In 1913 Collis described an outbreak of an unusual cough among weavers in north-east Lancashire. The condition was associated with constriction of the chest, an irritating cough, purulent sputum,

dyspnoea on effort, and asthmatic attacks. The material woven was cotton, sized with a mixture of flour (derived from wheat, sago, or potatoes), tallow, china clay, and water without any preservative. Just before the onset of the illness the warp threads developed a mildew while on the looms. When dry threads were substituted the symptoms disappeared. A recurrence of mildew on the yarn led to a reappearance of symptoms. In another mill where there was a sharp division of mildewed and unaffected warps only the weavers working on the former became affected. Collis concluded that the illness was due to mildew and compared the condition to that of aspergillosis.

Bridge (1924) and Middleton (1926) described similar attacks of weaver's cough due to mildew.

Vigliani, Parmeggiani, and Sassi (1954) described an epidemic of bronchial asthma among the weavers of a large cotton factory. In this instance the cotton yarn was sized with carob flour and potato starch. Fifty per cent. of the weavers had been affected with a dry cough, scanty sputum, dyspnoea, and rasping in the throat. Symptoms were worse on Mondays. On examination 105 weavers were affected with bronchial asthma, 27 of them severely. In the slight cases the attacks lasted for two or three months while the more severe cases lasted for five to six months. It was assumed that the epidemic was similar in origin to those described by Collis but investigations carried out towards the end of the epidemic did not disclose any particular abundance of moulds. Indeed, the atmospheric contamination of bacteria and fungi was greater in the spinning and weaving preparation departments, which were not affected by the epidemic. Skin tests with mould extracts were negative except for *Aerobacter aerogenes* which gave a positive reaction in 46% of the controls, in 76% of the moderate and slight cases, and in 100% of those severely affected. The organism, however, was either very scarce or absent in samples of the yarn and dust from the weaving department.

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It was considered that as the bacteriological and immunological investigations had been delayed until the epidemic was abating no conclusions could be reached concerning the cause of the epidemic.

One other outbreak in which workers exposed to vegetable dust suffered acute respiratory symptoms is worthy of mention. This was reported by Hunter and Perry (1946) and occurred in workers with crushed sugar cane after extraction of the sugar (bagasse). Symptoms usually began after eight weeks' exposure. The attack began with an acute febrile illness, extreme shortness of breath, cough, and scanty, black, stringy sputum. Chest radiography showed temporary miliary shadows and the whole picture suggested an acute bronchiolitis which usually cleared in about six weeks. This condition was not considered by Hunter to be a true pulmonary mycosis.

The Present Outbreak

The factory most severely affected in the present outbreak was a large weaving shed containing 1,200 belt-driven Lancashire looms. Ventilation was provided by a few opening lights in each bay of the saw-toothed roof and a row of small extractor fans along one wall. There was no air-conditioning or artificial humidification. The cubic space per individual, excluding machinery, was of the order of 1,000 cubic feet.

In January, 1956, an unusually high sickness absence rate became apparent, much in excess of that experienced during January, 1955, or 1954. This was in marked contrast to a neighbouring weaving shed, of similar type, where the size used was locust bean gum. The excess in sickness absence increased further during February and March and there was no sign of a decline until the end of May. This occurrence could not be attributed to any general epidemic or to adverse weather conditions. Indeed, meteorological observations in the area indicated that it had been a particularly mild March and April and many chronic bronchitics working in the factory said that it had been their best winter for some years.

The firm had begun using tamarind size in October, 1955. Initially only three warps were sized but the results were so encouraging that 20 warps were treated. With continued good results all spun rayon warps were sized with tamarind.

The extent of the use was as follows:—

	Bags of 100 lb.	Warps
October, 1955	12	72
January, 1956	12	72
February, 1956	54	324
March (part), 1956	28	168
	106	636

By the middle of March complaints of coughing among the weavers became so clamant that the size, as the only new material in use, was suspected as the cause of the trouble and its use ceased. By that time a total of 636 warps had been sized with tamarind. The warp may not get into the loom for two to three weeks after sizing and it remains there for four to five weeks so that any risk inherent in the material would be prolonged beyond the date at which sizing ceased until six to eight weeks later. In fact, this time was lengthened because so many weavers were off sick.

There were 180 men and 208 women working in the weaving shed, but 16 of them were excluded from consideration for the following reasons:—

	Men	Women
Intermittent, vague, or very slight exposure	6	3
Clinical condition (1 hypertension, 1? neoplasm, 1? coronary)	1	2
Absent throughout relevant period	1	3

Their occupations were as follows:—

Occupation	Men	Women
Weavers	73	144
Overlookers	21	—
Winders—unsized weft only	—	38
Warehousemen	12	—
Cloth lookers	10	—
Warp pinners	—	11
Others	64	15
Total	180	208

Thirteen of the men (five weavers, three overlookers, and five others) had been working with nylon and terylene in a separate department and had not been directly exposed to any hazard from tamarind size. The 38 winders and two women in other occupations had similarly not been exposed. It was therefore possible to compare the incidence and type of sickness of the two groups, those who had been directly exposed to tamarind and those who had not been so exposed.

Details of sickness absences were supplied by the firm. The total population of 388 men and women were interviewed individually. Information was thus obtained of previous illnesses and of any symptoms which had occurred during the past six months. It was found that, during the period January 1, 1956, to May 14, 1956, there had been a highly significant excess of absenteeism (Table 1) among the exposed women ($P < 0.001$, $\chi^2 = 19$). Too few men had not been exposed to be able to make any valid comparison.

There was no evidence that this excess of absenteeism could be attributed to a difference in age distribution. Although the mean age of the

TABLE 1

ABSENCE IN MEN AND WOMEN EXPOSED AND NOT EXPOSED TO TAMARIND HAZARD FROM JANUARY TO MAY, 1956

	Men		Women	
	Absent	Not	Absent	Not
Exposed	51	116	106	62
Not exposed	4	9	10	30
Total	55	125	116	92

exposed women (39.3 years, standard error 1.0) was slightly greater than that of the unexposed (36.6 years, standard error 1.7) the difference was not significant.

The reasons given for absence were examined and are shown in Table 2.

TABLE 2
CAUSE OF ABSENCE AND EXPOSURE

Cause of Absence	Men		Women	
	Exposed (167)	Not Exposed (13)	Exposed (168)	Not Exposed (40)
Cough and/or breathlessness	32	1	71	1
" Influenza "	3	—	6	3
Throat infection	2	1	3	—
Non-respiratory diseases	7	—	9	3
Injuries	4	—	6	—
Domestic duties	1	2	9	2
Other	2	—	2	1
Total	51	4	106	10

The two groups of women show a similar incidence of domestic duties (5% and 2/40) and non-respiratory disease (7% and 3/40) as reasons for absence. The very large total difference is mainly due to absences attributed to cough and/or breathlessness. When this category is combined with " influenza " (of which there is a slight increase among the unexposed) the resulting excess among the exposed is highly significant ($P < .001$, $\chi^2 = 17$).

There was no evidence that sickness absence during this period was influenced by a history of a previous chest illness (Table 3).

TABLE 3
MEDICAL HISTORY AND ABSENCE

Medical History	Men		Women	
	Absent	Not Absent	Absent	Not Absent
Chest illness	16	33	39	30
Nothing relevant	39	92	77	62

It was therefore apparent that the women who had been exposed to a direct hazard from tamarind size, primarily weavers, had had a sickness experience during the period January to mid May which was

fundamentally different from that of the women, primarily winders, who had not been so exposed, a difference which it was difficult to attribute to any cause other than occupation, and which had resulted in symptoms of cough and/or breathlessness.

Of all those who had been exposed, 106 men (63%*) and 141 women (84%) were considered to have been affected. The symptoms ranged from a dry, throaty cough to an acute and severe respiratory distress. The effect was not produced on first exposure, a minimum period of at least two weeks appearing to be required for sensitization. Cough, dyspnoea, and purulent sputum were the most frequent complaints (Table 4). A greater proportion of women complained of irritation of the eyes ($P < 0.05 > 0.01$, $\chi^2 = 6.3$), a difference possibly due to occupation as 12 of the 14 men similarly affected were weavers.

TABLE 4
FREQUENCY OF SYMPTOMS

Symptom	Men (106)		Women (141)	
	No.	(%)	No.	(%)
Cough	95	90	135	96
Sputum	72	68	83	59
Purulent	15	14	21	15
Other	72	68	100	71
Dyspnoea	68	64	81	57
Chest tightness	52	49	77	55
Irritation of throat	39	37	59	42
Wheezing	14	13	37	26
Irritation of eyes	27	25	54	38
Other				

Age did not appear to have influenced the chances of a woman becoming affected. The mean ages of those who had and had not suffered any ill-effects were 39.3 years (standard error 1.1) and 39.0 years (standard error 2.8) respectively.

The men showed rather a different picture. There appeared to be a greater propensity to succumb as age increased (Table 5). This finding can be partly accounted for by the fact that the most susceptible group, weavers, were older than the remainder. There was, nevertheless, a substantial difference in the ages of both weavers and others who had and had not been affected.

TABLE 5
AGE, OCCUPATION AND AFFECTATION OF MEN EXPOSED TO TAMARIND

Occupation	Affected	No. in Group	Mean Age (years)	Standard Error
Weavers	No	9	35.5	5.5
	Yes	59	48.3	1.4
Others	No	52	40.1	1.8
	Yes	47	49.4	1.9

* Fifty-nine (87%) male weavers were affected compared with 63% of all exposed men, a significant excess ($P < .001$, $\chi^2 = 27$).

A history of a previous respiratory illness or a history of allergy did not appear to have any bearing on whether or not men or women became affected (Table 6).

TABLE 6
MEDICAL HISTORY AND AFFECTION OF WORKERS
EXPOSED TO TAMARIND

Medical History	Men		Women	
	Affected (106)	Not Affected (61)	Affected (141)	Not Affected (27)
Previous chest illness	29	15	47	12
Allergic history	5	2	5	3

A feature of the condition was a history of returning to work after sickness absence and finding the symptoms recurred as badly as ever within one to four hours. Some people made three or more attempts to return and each time they became acutely distressed within a short period, although they had been feeling quite fit for some time beforehand and again recovered soon after they had left the factory. Indeed, in all cases removal from exposure resulted in dramatic improvement.

The following are some typical case histories:—

Mrs. T., aged 46, had been a weaver all her working life and except for an occasional cold had never had any illness. In March, 1956, she developed over three weeks a hard, dry cough with a very thick spit in the mornings. She felt hot and feverish and went to bed for two days after which she felt better but still a little weak. A week later she started work and was seen after two hours in the mill to be having difficulty in breathing. She complained again of cough and a burning sensation in the front of the chest.

Mrs. F. McC., aged 54, a weaver all her working life, had never had any chest trouble until the end of February, 1956, when she developed a headache, fullness in the nose, and a hard cough. She took two days off but on her return felt short of breath, particularly at night to such a degree as to feel frightened. On three occasions when her symptoms had disappeared after two to three days at home she returned to work to find that after about two hours she was as bad as ever.

Mrs. D. M., aged 46, a weaver all her working life, had never had more than an occasional cough until early in March, 1956, when gradually over 10 days she developed an irritating cough with a viscid sputum, tightness of the chest, and difficulty in walking up a slope. She stayed off work and felt better after two or three days but on returning at the end of a week she felt a stuffiness in her nose and had a shivering attack. The cough returned, associated with more copious purulent sputum, and spasmodic in character. Smoking made it much worse. After a further week off she returned and was seen after two hours with cough, tightness of the chest, and severe dyspnoea.

Mr. S. F., aged 47, a loom overlooker, had good health up to the beginning of March, 1956, when he developed

a cough, with dryness of the throat and tightness of the chest. He became so short of breath that he had to take a bus home instead of walking as he usually did. The cough was worse in the mornings and was associated with a scanty thick spit at first, which became more copious later. After two weeks off work he returned but on the second day was as bad as ever. This time he also lost his voice.

Mr. J. W. P., aged 53, a weaver all his working life and a champion swimmer, had never had a chest illness until Christmas, 1956, when he began to get spasms of coughing. These became worse and were associated with a sore throat, thick spit, tightness of the chest, and difficulty in taking a deep breath. The attacks tended to be worse on Mondays but remained throughout the week. They were similar to the effect of inhaling chlorine. He lost 14 lb. in 12 weeks.

Experiences in Other Factories

Investigations were made at two other factories weaving spun rayon. In the first factory, 45 people had been exposed to tamarind size, of whom 43 were questioned. It was apparent that the numbers affected and the pattern of symptoms were very similar to the findings in the original group.

TABLE 7
NUMBERS AFFECTED IN OTHER FACTORIES

	Men (26)		Women (17)	
	Affected	Not Affected	Affected	Not Affected
Weavers	9	2	14	3
Others	7	8	—	—
Total	16	10	14	3

The third factory had been somewhat less affected, but several similar cases had occurred.

Velvet Cutting

In the manufacture of cotton velvet a special type of cloth is woven. It has a surface composed of a number of tiny loops each of which must be cut to form the characteristic pile. The cloth is first sewn to form an endless loop and then passed through a cutting machine several thousand times, depending on the width of the cloth and the closeness of the loops. At each passage one row of loops is cut by a special knife.

In order to withstand this severe treatment the cloth is sized. The size is made up as for weaving, the rate of application is the same as for spun rayon yarn, and roughly the same amount leaves the cloth during treatment. Although cotton has not the same tendency to "fly" as spun rayon the operation is nevertheless a dusty one.

Investigations were made at three velvet cutting factories. The sickness records of the one firm

showed that there had been a substantial increase in absence during January to April, 1956, over that experienced in 1955. The symptoms of the respiratory illnesses which had occurred in all three were similar to those found in the weaving factories. There appeared to be no doubt that they were attributable to the same cause although the proportion of people affected was less: 16 out of 84, 15 out of 39, and five out of 27 respectively.

Tamarind Powder

Tamarind powder is obtained from the kernel of the seed of the tree, *tamarindus indica*. In India it has, during the last few years, entirely replaced starch for the sizing of jute and to some extent also of cotton yarns. Its use conserves the food starches and is held to have certain advantages over starch from the weaving and finishing standpoints. This success in India led to an investigation in the United Kingdom.

Several independent analyses have been made of tamarind seed kernel powder. They indicate that the main constituent is a carbohydrate and Sarkar and Mazumdar (1952) concluded that it is probably a glucoside. Assuming that all the nitrogen occurs as protein and the sugars as anhydrosugars, Sarkar and Mazumdar give the approximate composition of tamarind seed kernel powder in Table 8.

TABLE 8
APPROXIMATE COMPOSITION OF T.S.K. POWDER (OVEN-
DRY BASIS)

Constituent	Commercial Sample (%)	Laboratory Sample (%)
Glucosan	47.2	49.8
Xylan	20.5	19.7
Protein	17.5	18.8
Fat and wax	8.2	7.5
Mineral matter	2.5	3.4

On the other hand, Savur (1955) states that tamarind seeds contain three distinct polysaccharides, namely, P.1 readily soluble in cold water, P.2 which dissolves after an hour's stirring at 25° to 28° C., and P.3 which dissolves only on boiling. He also states that the oil fraction contains palmitic, stearic, arachidic, behenic, oleic, and linoleic acids, and that sitosterol is present.

Laboratory and mill trials carried out by the British Cotton Industry Research Association demonstrated that tamarind seed kernel powder was a practicable sizing adhesive for spun viscose cloth. It gave a better finished handle than the traditional sizes and the ease of de-sizing (by washing in hot water) was an important advantage.

The powder is mixed with cold water, 10% tallow, and 1% preservative (0.8% sodium silicofluoride

and 0.2% beta-naphthol) and boiled for an hour. It is applied at the rate of 9% on the weight of the warp yarn so that each square yard contains approximately 4.5 g. of tamarind seed kernel powder, 0.5 g. tallow, 0.04 g. sodium silicofluoride, and 0.01 g. of beta-naphthol.

Atmospheric and Skin Tests

Towards the end of the outbreak and just before the last tamarind-sized warps were removed Dr. Tuffnell, of the Bacteriology Department, University of Manchester, carried out estimates of bacteria and fungi. No undue concentration was detected in the air of the shed. Viable fungi amounted to only 7 per cu. ft., and viable bacteria to 15 per cu. ft. The species and the low concentration do not suggest that they were a likely factor in the production of the illness.

With the assistance of the importers of tamarind seed kernel powder and the British Cotton Industry Research Association several fractions were prepared and used for intradermal patch and scratch testing. No conclusive results were obtained.

Discussion and Summary

It has been established that an unusual and widespread outbreak of cough and dyspnoea occurred among weavers of viscose yarn, in which tamarind seed kernel powder had been used as a sizing agent. The condition appeared to be a reaction to a constituent of the size.

The preservatives (fungicides) are unlikely to have been responsible. They were originally suspected by the importers and were left out of subsequent deliveries, without any apparent change in effect. A fungus or other organism is also unlikely to have been the activating agent, since fungicides were present in the material which first produced symptoms and no undue concentration of fungi was detected in the atmosphere of the weaving shed.

The presence of purulent sputum in so many cases raises the question of an infective or irritant factor but an allergic reaction is more clearly indicated by the period of sensitization and the fact that those with a previous history of chest disease were not the more severely affected. Negative or equivocal skin reactions are commonly encountered in such cases of allergy.

As the use of the suspected size has now been discontinued confirmation of these hypotheses can only be obtained by inducing a reaction under controlled conditions. In this way various components of the size can be eliminated and such comparative measurements as timed vital capacities and white cell counts might give an indication of the nature of the condition. This work is in progress.

We are very grateful to the workers and employers whose cooperation made this investigation possible. We should especially like to thank Mr. T. Brown and Miss P. Thomson of Glenfield Mill, Nelson, Dr. D. Hill, of the Shirley Institute, and Mr. Shaw, of the Nelson and District Weavers Association.

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Congresses on Occupational Health

XIIth International Congress on Occupational Health

The XIIth International Congress on Occupational Health will be held in Helsinki from July 1 to 6, 1957. The Committee hopes that the Congress will receive the cordial support and attendance of doctors, engineers, chemists interested in occupational medicine and hygiene, research workers and teachers in this field, social insurance workers, industrial and public health nurses, and others. The International Social Security Association will assist in the preparation of the reports concerned with the social aspects of occupational health.

The preliminary programme is divided into (1) Congress subjects, (2) section subjects, (3) reviews, (4) round table, and (5) group meetings. The Congress subjects are:—Industrial noise, evaluation of invalidity, industrial hygiene norms, and cardiacs and work.

There will be an opportunity before and after the Congress for members to visit and acquaint themselves with the organization and operation of occupational medicine and hygiene in other Scandinavian countries. There will be an excursion on July 7 to industrial establishments and hospitals in various parts of Finland.

The official languages of the Congress are English, French, German, and Spanish.

In addition to the general social programme, a special programme will be arranged for the ladies of the Congress.

The Nicolo Castellino prize, value 3,000,000 lire, will be awarded for the first time at the Congress at Helsinki. The award will be made for what, in the opinion of the assessors, is adjudged to be the most outstanding investigation in the field of occupational health by a research worker, who must be under the age of 35 years and is not the holder of a university chair. Details of the competition will be published at an early date by the Directors of the Fund or can be obtained direct from Directors of Nicolo Castellino Prize, The University, Naples, Italy.

To discover the best films in the field of occupational

health a film competition will be organized in connexion with the Congress.

Detailed information can be obtained from the Organizing Committee.

The Congress fee for members is £5.8s. and for associate members £3.12s.

Notification of intention to be present must be made by May 1, 1957. Hotel accommodation cannot be guaranteed after that date.

Details of the preliminary programme and any further information relating to the Congress may be had on application to the Organizing Committee, c/o Työterveyslaitos, Haartmaninkatu 1, Helsinki-Töölö. Chairman, Dr. Leo Noro, and Secretary-General, Dr. Pentti Sumari.

Post-graduate Courses on Advances in Occupational Medicine

From Thursday, August 1, to Thursday, August 15, 1957, the first Latin-American post-graduate course on advances in occupational medicine will be held at Caracas, Venezuela, organized by the American Union of Occupational Medicine.

The American Union has invited the collaboration of well-known European and American authorities on industrial medicine to ensure a high scientific standard. The course can be attended by doctors, industrial engineers, and industrial chemists.

Venezuela's Government has offered lodging at the University's residence and meals prepared by the National Institute of Nutrition at very reasonable prices.

Each participant in the course will receive a special certificate and copies of the proceedings.

The course will be coordinated by Professor Dr. José Pedro Reggi, Argentine, General Director of the American Union of Occupational Medicine.

The Secretary's Office of the American Union of Occupational Medicine, Arenales 981, Buenos Aires, Argentina, will give all the information required.