

THE OCCURRENCE OF MITES (ACARINA) IN HUMAN SPUTUM AND THEIR POSSIBLE SIGNIFICANCE

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In this note the results of some preliminary observations on the presence of mites in human sputum are recorded. At the present stage of the investigations, the presence of mites of various species has been detected in the sputum of 17 out of 28 persons examined. Twenty-four of these persons were under observation or receiving treatment for respiratory disorders in a local hospital; they were of several different nationalities and none had resided in Ceylon for more than a few months. The remaining four persons (three Europeans and one Ceylonese) had lived in Ceylon for periods of from three to over twenty years; all of them gave histories of long-standing coughs and asthma.

Precautions against contamination of sputum samples

The presence of mites was first observed during the examination of a sample of sputum, from one of the hospital cases, for tubercle bacilli. This led to the examination of further samples of sputum from the same case, and from other cases suffering from chest complaints. The results were remarkable, and mites were found with such frequency that contamination

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from outside sources was seriously suspected. This suspicion was increased when it was found:

(a) that the mites which were being recovered from the sputum were not related to those species which are known to be true parasites in the lungs and air passages of monkeys and certain other mammals, but were species which are commonly present in stored products and debris in houses, shops, etc.;

(b) that mites of various kinds were present in dust and brushings obtained from the hospital and laboratory premises;

(c) that at least one of the mites present in the sputum samples was air-borne in the wards.

At an early stage in the investigations, therefore, precautions against contamination were taken whenever practicable, and results from samples of sputum to which the least doubt attached regarding the efficiency of such precautions were registered separately. In all cases in which the precautionary measures were considered to have been satisfactory, the samples of sputum were discharged direct into large test-tubes or screw-capped bottles which had been previously prepared for the purpose. These test-tubes and bottles had been thoroughly washed and cleaned and subsequently flushed for 5 minutes in running water. The tight-fitting rubber stoppers of the test-tubes and the caps of the bottles were subjected to the same treatment; they were removed only at the time of expectoration during which they were held in the hand, and after which they were immediately replaced.

Controls, using distilled water without precautionary measures, were carried out at times when specimens of sputum were being collected; and vessels containing distilled water were exposed overnight in the vicinity of mite-infected patients, and in other parts of the wards and in the laboratory. No mites were observed in any of these experiments.

The possibility of the mites being derived from the mouth or nasal passages of the patients was also investigated, and several samples of saliva and nasal washings were examined. So far, however, no mites have been recovered from these samples.

As previously stated, the results obtained from the samples of sputum taken with precautions of doubtful efficiency were registered separately. An analysis of the examinations made gave the following data:—

Efficiency of precautionary measures doubtful	..	..	63 samples
Number with mites	..	..	25 (39.7 per cent)
Efficiency of precautionary measures not in doubt	..	..	44 samples
Number with mites	..	..	21 (47.7 per cent)

Mites occurred, therefore, in both types of samples and were actually more prevalent in samples collected under precautions which rendered chances of contamination from outside

sources extremely remote. This latter fact however has no significance since precautionary measures were, in many cases, most strictly applied when there were reasons for suspecting the presence of mites. It may also be noted that the samples in the first category included 17 from 11 persons in whom no mites were found at any time; and that in all persons in whose sputum mites were originally found, the finding was subsequently confirmed in sputum samples collected in the manner described above.

In view of these facts, it is believed that while contamination of unprotected sputum samples by mites from outside sources is a definite probability and may have occurred to a limited extent in some of the samples examined, it is a remote possibility in protected samples collected as described above, and could not *per se* provide an explanation of the findings recorded. Indeed, we consider that the evidence obtained (see also case 3, page 166) leaves no room for doubt that in some cases at least the mites were derived from the lungs and/or bronchi of the persons under observation.

Method of examination

Mites or portions of mites were first seen in smears of sputum obtained by the flotation method (Proctor, 1941) used for the detection of tubercle bacilli. These specimens, however, were much distorted and too badly damaged to allow of identification. Fresh sputum was then examined under the binocular microscope, and occasional mites—sometimes embedded in plugs of mucus—were found. This, however, was a very laborious and objectionable proceeding and was discarded as unsuitable for routine purposes. The method subsequently was as follows:—

The fresh sputum was treated in the first place with an equal quantity of 1 per cent potassium hydroxide; this was shaken and allowed to stand until the mucopurulent material had disintegrated. After a few hours, when the mixture had become more or less clear, from 5 to 10 drops of Löffler's alkaline methylene blue were added and the solution again shaken. Formalin sufficient to give a 10 per cent concentration was then introduced, and the mixture left until the next morning (18 to 24 hours). The mixture was then centrifuged and the supernatant fluid drawn off; the deposit was examined under a binocular microscope.

Throughout the whole of this procedure every care was taken to ensure that no contamination with mites from the reagents or vessels used occurred.

By this process the mites were well stained and showed up clearly; they were picked up on a very fine spatula (made of platinum or silver wire) and placed in a 10 per cent solution of potassium hydroxide in an excavated slide in order to clear. The initial examination of the mites was done while they were still in the caustic potash; the mites being mounted in excavated slides, no distortion due to pressure occurred, and manipulation of the coverslip readily enabled the specimens to be studied from any desired angle. In cases where the clearing

of the mites by caustic potash was not successful, further treatment with glacial acetic acid often produced the desired effect.

When permanent preparations were required the mites were treated as follows:—

They were transferred to distilled water and subsequently to glacial acetic acid for 2 or 3 minutes, and then placed in a weak solution of carbol fuchsin—15 drops of the stain to 15 c.cm. of distilled water—and kept under observation until the desired degree of staining had been reached. The specimen was then removed to a flat slide and mounted in a medium consisting of gum arabic (30 grammes), glacial acetic acid ($\frac{1}{2}$ c.cm.) and distilled water (60 c.cm.). This medium hardened and set in from 24 to 48 hours in Colombo.

Types of mites present in the sputum

It is not proposed in this note to give detailed descriptions of the various mites found in the sputum, or to attempt any pronouncement upon their specific identification. Such identification requires further research and access to literature which is not available at the moment. Nevertheless a careful study of the numerous specimens obtained has led to the conclusion that at least ten species of mites are represented in the collection.

The majority of the specimens recovered from the sputum samples belonged to the genera *Tarsonemus*, *Tyroglyphus* and *Carpoglyphus*; but a species of *Glyciphagus* was present in two samples, of *Cheyletus* in one sample, and species referable to three unidentified genera in six samples.

Two species of *Tarsonemus* were found. The larger of these occurred in one sample only, but the smaller species was the most prevalent of all mites found in the sputum of the persons examined. It was present in 41 (75.9 per cent) of the 54 samples in which mites occurred. Both sexes were observed, but the males were much less frequent, being found in four (7.4 per cent) samples only. No eggs, larvæ or nymphs of this species were seen in the sputum. This mite is minute, the females ranging from 120 to 145 microns in length, and the males—which differ greatly from the females in appearance—from 90 to 115 microns. From the description of the male given by Hirst (1920) it appears to be closely related to *T. floricolus*, a species credited with a wide range of habitats including flowers, galls, decaying substances and the human urinary tract. Adults of a species of *Tarsonemus* indistinguishable from that present in the sputum were also found in dust and in the air of the wards and laboratory. Small samples of dust were collected from a variety (66) of situations in the wards and laboratory of the hospital, in the entomological laboratory, in houses and small shops ('boutiques') in Colombo, and in rest-houses in different localities. The *Tarsonemus* occurred in 15 per cent of the samples of dust examined, the infested samples including brushings from furniture and bedsteads in the wards and some of the rest-houses. From one of the samples—a small piece of fluff from the inside of the spring of a wire mattress of a bed used by one of the mite-infested patients—as many as 28 mites were obtained; 12 of these (11 females and one male) were apparently identical with the smaller of the two species of *Tarsonemus* found in the sputum. On four occasions, air was extracted from the wards and laboratory of the hospital by means of a filter pump using distilled water, and it was estimated that approximately 5 or 6 cubic feet of air were extracted in each experiment. The same species of *Tarsonemus* (in all 4 females) was recovered from the distilled water in two of the experiments.

The so-called Tarsonemid mites include many forms with widely diverse habits and modes of development, and many species which are of considerable economic importance. In Ceylon, the species *T. translucens* is an important pest of tea bushes, and elsewhere various species have been recorded attacking rice, grasses, pine-apples, sugar-cane, and other crops. *Pediculoides ventricosus*, also a Tarsonemid, commonly feeds upon insects living in grain, straw, etc., but sometimes attacks persons handling infested materials, producing a dermatitis usually known as 'grain itch' or 'straw itch'. Other members of this group of mites are parasitic in the respiratory system of honey-bees and grasshoppers, and, in the former, cause the serious condition known as 'Isle of Wight' disease.

Mites of the genera *Tyroglyphus*, *Carpoglyphus*, and *Glyciphagus* were found in 15 samples of sputum all but one of which were obtained from the same person at different times.

The species of *Tyroglyphus* found was apparently *T. longior*; single specimens of this mite were obtained in each of 10 samples of sputum, the specimens being 1 larva, 3 nymphs, 4 females, 1 male, and 1 nymphal skin. A species of *Carpoglyphus*, closely allied to or identical with *C. anonymous* Michael, occurred in 2 of 25 samples of sputum examined from the same person (case 3, see p. 166); 26 specimens, or portions of specimens, of this mite were found in the third and seventeenth samples (interval 38 days); 25 of these specimens were present in the latter sample which was obtained a day after the patient had been treated with stovarsol. These 25 specimens were as follows: 10 larvæ, 4 nymphs, 3 females (two of which contained eggs with well-developed larvæ), 2 males, and 6 adults in which the capitulum and first and second pairs of legs only were present and the sex indeterminate. Three specimens, a larva and two nymphal skins of a species of *Glyciphagus* were also found in samples of sputum from this case. Eggs—apparently of *Tyroglyphid* mites—were found in sputum on two occasions.

The genera *Tyroglyphus*, *Carpoglyphus* and *Glyciphagus* are all contained within the family *Tyroglyphidae*, and include the well-known cheese and sugar mites. Several of the species are very abundant and of much economic importance. They frequently swarm in great numbers in stored products and may cause considerable damage. Michael (1901-03) states that they 'swarm in houses generally', and are carried by 'wind, water and other agencies'. Hirst (1920) notes that persons whose work brings them into contact with materials infested with these mites are apt to suffer from forms of dermatitis variously known as 'grocers' itch', 'copra itch', 'Vanillisme', and 'water itch'. Few of these mites are parasitic, but there can be no doubt that they are often ingested by human beings and may (Hase, 1929) produce disorders of the stomach and intestine. They have also been occasionally recorded from the human urinary tract.

The record of *Cheyletus* from the sputum is remarkable as the mites of this genus are predatory and solitary in habit; they are, however, often associated with and often prey upon the *Tyroglyphid* swarms. The single specimen seen was found in the sputum of a person who was receiving treatment with stovarsol; it measured 405 microns in length and although in a macerated condition was readily recognizable.

It is not possible yet to offer any comments upon the unclassified mites found in the sputum. All that can be said at present is that eight specimens representing at least three genera were found in six samples of sputum from five different persons; single specimens of one of these species occurred in samples from three persons.

Observations on the findings and some case histories

In all, the sputum from 28 persons was examined, but in 12 of these, circumstances

permitted of very few (one or two) samples being taken. Eleven of the latter, from whom 19 samples were procured, showed no mites in the sputum. From the remaining 17 persons, 120 samples of sputum were examined, 32 of which were obtained from six cases subsequent to treatment with arsenical preparations. Mites were observed in 46 (52.3 per cent) of the 88 samples taken prior to any of the cases receiving treatment. Usually the mites in these samples were very scanty, the largest number recorded from any single sample being four; in the majority of instances one mite only was found in a sample. In eight of these 17 persons (22 samples examined), mites were seen once only, and in six of them the small species of *Tarsonemus* was the only mite found. In the remaining nine persons (66 samples), mites were present in from two to nine of the samples taken from the same individuals; *Tarsonemus* was found in every patient, but in no case was it the only species present. Records from the three individuals from whom the largest numbers of samples were taken were as follows:—

(a) Period of observation—36 days; number of sputum samples examined 16; number of samples with mites 9; largest number of successive samples without mites 2.

(b) Period of observation—65 days; number of sputum samples examined 13; number of samples with mites 7; largest number of successive samples without mites 4.

(c) Period of observation—20 days; number of sputum samples examined 10; number of samples with mites 4; largest number of successive samples without mites 3.

From the six persons who later received treatment with arsenical preparations, 37 samples of sputum were examined prior to treatment and 32 samples subsequent to treatment. Of the former 23 samples (62.2 per cent) showed mites, whereas of the latter only 8 samples (25 per cent) were positive, and in several of these the mites appeared to be in a partially macerated condition.

Reference has already been made to the fact that all the persons who came under observation were suffering from chest complaints. In several of the hospital cases in whose sputum mites were found, the patients were discharged following improvement of their condition, or were invalided when considered necessary by the hospital authorities. In a limited number of cases, however, it was found possible to extend the observations. Examination of the blood of ten of the hospital cases and three of the private cases was undertaken; in five of the former the blood picture was normal, and no eosinophilia was observed; in five others (including one private case) an eosinophilia of from 6 per cent to 12 per cent occurred; and in the remaining three an eosinophilia of from 38 per cent to 66 per cent

was found. Brief histories of these three cases are of interest:—

Case 1.—O. H., British, male, aged 42 years. Commenced having asthmatic attacks in July 1943, usually in the afternoon and evening. Blood examination 16th October, 1943: W.B.C. 14,000; eosinophils 38 per cent. *Trichuris* ova present in stools. Female of *Tyroglyphus longior* found in sputum at third examination. Treated with stovarsol, grains 10 daily from 18th to 27th October, 1943. No mites observed after treatment. X-ray 3rd November, 1943: general increase of striae and slight congestion of both bases. No evidence of tuberculosis. Blood examinations 3rd November, 1943, 12th November, 1943, and 16th November, 1943: W.B.C. 18,600, 13,600 and 12,600; eosinophils 36 per cent, 18 per cent and 16 per cent. Condition improved—no attack of asthma for last thirty days.

Case 2.—E. B., Indian, male, aged 39 years. Chronic bronchitis and low-grade pyrexia, cough and pains in chest for 2 or 3 months prior to entering hospital. X-ray suggestive of pneumoconiosis. Blood examinations 3rd September, 1943, and 11th September, 1943: W.B.C. 21,400 and 25,600; eosinophils 66 per cent and 58 per cent. Ova of *Enterobius vermicularis* present in stools. Sputum—4 samples examined, 3 with *Tarsonemus* (small species). Commenced treatment with N.A.B. on 12th September, 1943, in all seven doses, 245 grains over a period of three weeks. Subsequent samples (5) of sputum showed no mites except that of 29th September, 1943, in which a female of the large species of *Tarsonemus* was found. Blood examinations 22nd September, 1943, 1st October, 1943, and 9th October, 1943: W.B.C. 20,600, 12,000 and 11,200; eosinophils 60 per cent, 36 per cent and 11 per cent. Condition improved subsequent to treatment.

Case 3.—S. J., Ceylonese, female, married, aged 22 years. Admitted into a civil hospital 16th April, 1943, with history of pain in throat, cough and evening temperature of three weeks' duration. Examination showed follicular tonsillitis, swab negative to *B. diphtheriae*; chest resonant on percussion, breath sounds harsh with expiration prolonged; adventitious sounds—an occasional crepitation over right apex and rhonchi scattered. Cough troublesome at night, night sweats, evening temperature ranging from 98.6°F. to 99.5°F. X-ray 16th April, 1943: revealed patchy infiltration of both lungs, 'the appearance being suggestive of pulmonary tuberculosis'. Sputum examined for tubercle bacilli on five occasions between 17th April, 1943, and 26th April, 1943—all specimens were negative. Blood examination 19th April, 1943: W.B.C. 21,000; eosinophils 42.0 per cent. Faeces showed no worms; urine without deposits, normal. Treatment consisted of propepsine orally, expectorants, iodide mixture, Mandel's paint for tonsils and creosote inhalations at bedtime. The patient had been previously admitted into the same hospital for Caesarean section (21st September, 1942, to 17th October, 1942), pelvic cellulitis (22nd October, 1942, to 10th November, 1942), and appendicectomy (1st February, 1943, to 17th February, 1943). Blood examinations were made on 22nd October, 1942, and 1st February, 1943: W.B.C. 8,200 and 12,000; eosinophils 3 per cent and 8 per cent.

After discharge from hospital on 27th April, 1943, the patient moved to Colombo. The chest trouble and cough continued, and she was under medical observation and treatment for bronchial asthma. Attacks of asthma occurred at least twice a week, and night cough was often severe causing loss of sleep and lassitude on rising. Samples of sputum were first examined for mites early in September 1943; between 8th September, 1943, and 15th October, 1943, sixteen samples were examined and mites (*Tarsonemus*, *Tyroglyphus*, *Carpoglyphus* and an unidentified species) were found in nine samples. A differential blood count made on 13th September, 1943, gave an eosinophilia of 55.2 per cent. Treatment with stovarsol was commenced on 18th October, 1943, and was continued for 8 days (grains 10 on the first 2 days and grains 5 daily thereafter). All sputum expectorated after the first

dose, including that of the early morning of 19th October, 1943, was collected in a prepared tube and examined. No less than 29 mites—mostly *Carpoglyphus*—in all stages (see p. 165) were found in this sample. Eleven samples were taken subsequently (between 20th October, 1943, and 30th October, 1943) and eight mites of various kinds in a more or less macerated condition were found in six samples; the last three samples were negative. Differential counts made after commencement of treatment gave the following results: 22nd October, 1943—eosinophils 56.0 per cent; 1st November, 1943—eosinophils 18.2 per cent; 25th November, 1943—W.B.C. 8,000; eosinophils 20.0 per cent. By the end of November the patient's condition showed definite improvement, and she was 'feeling herself again'. The cough had ceased and no attack of asthma had occurred since the treatment with stovarsol.

The possible significance of mites in the sputum

Endoparasitism by mites in man has so far received relatively little attention, although mites are not infrequently present in human faeces and have occasionally been found in the urinary tract. Indeed, so far as we are aware, such endoparasitism has been specifically noted in man only in relation to infestation of the alimentary and urinary tracts, and we have failed to find any direct reference to infestation of the human respiratory system or to the presence of mites in human sputum. Endoparasitism of the respiratory system by mites is, however, known to occur in insects, birds, reptiles, and some mammals; and in certain Old World monkeys, mites of the genera *Pneumonyssus* and *Pneumotuber* are true parasites, infesting the lungs and air passages (pulmonary acariasis), and are capable of causing serious pathological conditions. As previously stated, however, the mites found in the sputum of the persons examined were not related to those parasitic in the lungs of monkeys, but were mainly of non-parasitic types which normally occur in stored products, decaying substances, and debris of various kinds. Nevertheless, it is particularly to mites of this type that the literature on endoparasitism in man relates.

Invasion of the human alimentary and urinary tracts by *Tarsonemid* and *Tyroglyphid* mites is believed to have been responsible in some instances for such disorders as gastro-enterocolitis, nocturnal enuresis, haematuria, and albuminuria. Dickson (1921) investigated two cases of infection of the urinary tract—one by *Tarsonemus* and the other by *Tyroglyphus (Aleurobius) farinae*. In the latter case the urinary symptoms had lasted many years and were supposed to be due to chronic Bright's disease; on cystoscopic examination *T. farinae* was found, especially in the trigone of the bladder. Mackenzie (1922) gave particulars of seven cases of invasion of the urinary tract by *Tarsonemus* and concluded that 'certain urinary disorders may be due to mites living parasitically in the mucous membrane of the urinary tract'. Hase (1929) in a review of the literature of the subject with special reference to *Tyroglyphidae* stated that disorders of the stomach and intestine caused by mites that infest stored products may in some cases be allergic and in others due to general toxic effect. He considered that symptoms of allergic disease caused by mites were usually associated with either the skin or the respiratory system, and that mites in houses and stores were a definite danger to health. Korkhaus (1933) in a further review of the literature relating to the parasitic and pathological

importance of the Tyroglyphidæ in animal tissue concluded that though these mites are not true parasites in such tissue, they may, when ingested with food, produce both in man and animals pathological symptoms of an allergic type. In relation to respiratory diseases Ancona (1923) noted that many workers in the grain mills at Barberino suffered from asthma together with a dermatitis of the neck, chest and arms; he attributed these troubles to the mite *Pediculoides ventricosus* which was present in the grain of those mills where the workers were affected, and suggested that the symptoms were probably the result of inhalation or the action of the mites on the nasal mucous membrane. von Lengerken (1929) quoted cases of sickness and death in horses caused by feeding on mite-infested maize; the symptoms included inflammation of the respiratory and digestive organs and lameness. Examination of the infested maize showed *Tyroglyphus (Aleurobius) farinæ* to be the commonest mite present, although *Glyciphagus domesticus* and *Cheyletus eruditus* also occurred.

We have already given reasons for our belief that in many cases at least the mites observed in the sputum of the persons examined were derived from the lungs and bronchi. That they have not been previously detected is probably mainly due to the methods ordinarily used for the examination of sputum. The chances of finding a mite in a smear made from a minute quantity of sputum—particularly when the examination is for tubercle bacilli only—are exceedingly slender; for even when collections consisting of 5 c.cm. to 40 c.cm. of sputum were examined as described above, it was unusual to find more than one or two mites in any one sample.

If our view that the mites were derived from the lungs and bronchi be correct, the questions which immediately arise are those concerning the mode or modes of infection and the duration of the infestation.

Upon the first of these points we can offer no direct evidence in respect of any of the cases observed. But the observations of other writers and the demonstrations referred to in this paper of the presence of mites in the dust of wards, bedrooms, and similar places, and in the air, suggest strongly that an important, if not the chief, avenue of infection is through inhalation. The liability to infection by this method would obviously be increased in situations such as stores, mills, barns and ill-kept or dilapidated houses when, as so often happens, Tyroglyphid and other mites are present in large numbers. But the possibility of inhalation of mites from unusual or unsuspected sources must also not be overlooked. Sweet-smelling flowers sometimes harbour mites; and in Colombo we have observed a species of *Tyroglyphus* swarming on the so-called 'Temple-tree flower' (*Plumeria acuminata*) so abundantly used for religious and ornamental purposes and for garlands. That infection of the respiratory system by indirect routes following ingestion of mites with food could occur seems unlikely, but Patton and Evans (1929) have suggested that the source of *Tarsonemus* in cases of infection of the

bladder may be the rectum, and that mites may have burrowed through the tissues.

It is probable that in some cases the endoparasitic infection by mites is of a transient nature, but the histories of some of Carnegie Dickson's and Mackenzie's cases, and of case 3 above, indicate that in some instances the period of infection may be much prolonged. In our view the evidence accumulated regarding case 3 suggests strongly that the infestation had lasted for a period of not less than seven months, and that the mites had adapted themselves to the conditions existing in the lungs and bronchi. The presence of these mites (*Tyroglyphus* and *Carpolyphus*) in considerable numbers in the sputum in all stages from eggs to adults of both sexes (including egg-bearing females) cannot, we suggest, be explained on any grounds other than that of these mites breeding in their unusual habitat.

Finally, it is important to consider whether the mites were living as commensals or as parasites. The existence of a considerable leucocytosis and eosinophilia in some of the cases has already been noted; and in case 3 at least, the blood conditions suggested the presence of endoparasites which the examination of the fæces and urine failed to reveal. The high eosinophilia observed (42 to 55 per cent before treatment) could not be explained if the reaction to the mites was purely mechanical as in the case of inert foreign matter. In this connection it is of interest to note that a condition 'characterized by massive eosinophilia with focal broncho-pneumonic infiltrations affecting both lungs, and general symptoms such as fever and loss of weight' (Chaudhuri, 1943) has recently attracted much attention in India; and that several writers on the subject have stressed the necessity for its recognition and differentiation from tuberculosis. Frimodt-Møller and Barton (1940) who described it as a 'pseudo-tuberculous condition associated with eosinophilia,' studied many cases almost all of whom had the usual symptoms of tuberculosis although few showed tubercle bacilli in the sputum. They considered that the lung condition 'characterized by an evenly distributed extensive mottling of small nodular shadows over both lung fields, with increased linear markings', was not due to tuberculosis and was probably allergic in origin. Weingarten (1943) described what was evidently the same condition as a new disease entity which he termed 'tropical eosinophilia', and other authors have discussed it under the names 'eosinophil lung' and 'benign eosinophil leukæmia'. Weingarten's 'tropical eosinophilia' was characterized by definite bronchial and pulmonary conditions and a massive eosinophilia unassociated with the presence of internal parasites as shown by examination of the blood, fæces and urine. He considered that the disease was benign but could last for many years, and that many cases had previously been diagnosed as pulmonary tuberculosis or chronic bronchial

asthma. Arsenical preparations were ultimately found by this author to be the most effective form of treatment and to be followed by a remarkable fall in the eosinophilia; and this discovery was subsequently confirmed by other workers.

The aetiology of this variously named condition has hitherto been regarded as obscure, but in view of our findings and of the results obtained from the administration of arsenic—pre-eminently a parasiticide drug—we suggest that the condition may be due, in part at least, to mite infestation of the respiratory system.

Summary

1. The occurrence of mites in the sputum of 17 out of 28 persons suffering from respiratory disorders is recorded.

2. Some of the mites found in the sputum were also shown to be present in dust and in the air, and contamination of the samples from outside sources was suspected. The precautions to prevent contamination, and the methods of examining the sputum and the mites are described.

3. At least ten species of mites, some of which have not yet been identified, were found in the sputum. Those identified were not parasitic types, but were species which are commonly present in stored products and debris of various kinds. They included species of *Tyroglyphus*, *Carpoglyphus*, *Glyciphagus*, *Cheyletus* and *Tarsonemus*.

4. Prior to treatment with arsenical preparations, mites were found in small numbers in approximately 50 per cent of sputum samples taken from the mite-infested persons. After arsenical treatment the numbers of mites found in the sputum diminished, and many of those seen appeared to be in a macerated condition.

5. In three of the mite-infested persons, an eosinophilia of from 38 per cent to 66 per cent was observed. In all of these, the chest conditions improved and the eosinophilia was much reduced following treatment with arsenic.

6. In one case, 29 mites, mostly *Carpoglyphus*, in all stages, were expectorated immediately following the initial dose of stovarsol.

7. It is considered that the evidence obtained suggests strongly that the mites observed in the sputum were derived from the lungs and/or bronchi, and that in one case at least the mites had adapted themselves to the conditions present and were breeding therein. The evidence also suggests that the chief method of infection is by inhalation, and that infestation may in some cases be of prolonged duration. The view is advanced that the condition variously known as 'pseudo-tuberculosis', 'eosinophil lung', 'tropical eosinophilia', etc., may, in part at least, be explained on the basis of mite infestation of the respiratory system.

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RECENT EXPERIENCES IN THE SYMPTOMATOLOGY AND TREATMENT OF PLAGUE

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AFTER nearly 20 years, bubonic plague broke out in this town in the middle of June 1943. It continued for nearly four months, and 210 people died from it. The municipal council erected a temporary hospital for the isolation and treatment of plague patients and I was entrusted with the charge of this hospital. One hundred and fifty-one patients received treatment in hospital, and 139 patients were treated by me in their homes.

Administration of sulphonamides by oral and parenteral methods was the chief form of treatment adopted. Preparations of sodium sulphapyridine, sulphapyridine, and sulphathiazole were

(Continued from previous column)

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