and boots renders invasion of the skin by *Ancylostoma* larvae improbable; (3) "ground itch," associated with skin invasion by *Ancylostoma* larvae, is not seen; (4) mass infestation by *Ancylostoma* yields a considerable proportion of cases of grave anaemia; (5) anthelmintic drugs have been found to be almost useless in eradicating the worms; (6) the ova agree in every detail with the published description of *Trichostrongylus*; and (7) ova identical with those found in man were observed in a series of sheep examined.

Details of these findings and conclusions were therefore circulated among the company's medical officers, recommending that anthelmintic treatment should not be employed for the presumed *Trichostrongylus* infestations but only for the other helminths reported.

Symptomatology of *Trichostrongylus* Infestation

Maplestone (1941) considers that no significant symptoms occur in man. Faust (1939) considers that a heavy infestation may produce a severe secondary anaemia, but in the series encountered here the ova have always been scanty. In Abadan, in 1946, of 150 labourers who had been diagnosed as suffering from "hookworm disease" only six cases had a haemoglobin of less than 10 g. % and only one of these had a reading of less than 7 g. %. It seems probable that these six men were the genuine cases of ankylostomiasis in the series.

Forty healthy and symptomless school-children aged between 10 and 12 years were sent for investigation by the schools medical officer. Thirty-one were passing *Trichostrongylus* ova, and this provides additional evidence of the trivial nature of the infestation.

Mode of Transmission.—Man contracts the infestation by swallowing the larvae, and Watson (1946) quotes a number of isolated cases in Europe and the United States which were traced to sheep or goats. Although these animals are numerous on Abadan Island, few of the labourers are in close contact with them. Presumably the parasite is now being passed from man to man.

Diagnosis.—Watson in his paper deals at length with the points differentiating *Ancylostoma* ova from *Trichostrongylus*. He states that segmentation in tropical heat is so rapid that any delay in examination renders this distinction useless. The 1,000 cases examined in Abadan all passed stools on paper in the latrines adjoining the laboratory and handed the specimen to a technician immediately. Consequently the degree of segmentation has been of considerable diagnostic value.

Summary

An investigation of the relative frequency of human infestation with *trichostrongylus* in South Persia is described: 70% of the inhabitants carry the harmless sheep parasite *Trichostrongylus* and 25% the common *Ascaris*. Other helminthic parasites are rare.

A long-standing confusion of *Trichostrongylus* ova with *Ancylostoma* ova had occurred, with the provision of much ineffective treatment and waste of time. Part of a large labour force had been consuming unsuitable drugs intermittently, in some cases for a considerable period, and had thus been impeding the work of a very busy out-patient department.

I am indebted to Mr. A. C. Turner, Chief Medical Officer in Iran and Iraq, of the Anglo-Iranian Oil Company, for permission to publish this investigation, and to Professor J. J. C. Buckley, of the University of London, for criticism and advice.

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A CASE OF PULMONARY STRONGYLOIDIASIS

BY

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The following case presents two interesting features of *Strongyloides stercoralis* infestation with pulmonary manifestations. It is interesting as a case treated for 12 months for pulmonary tuberculosis.

Case Report

An Army sergeant aged 51, with 32 years' service in India, Gibraltar, Hong Kong, Singapore, Shanghai, Egypt, and Palestine, was admitted to the Military Unit, Harefield County Hospital, in March, 1947. He had had an acute illness in April, 1946, with pain in the right side of the chest, and was admitted to hospital, where he was found to have a right-sided pleural effusion. He was given 30 g. of sulphathiazole, an underlying lobar pneumonia being presumed, but the pyrexia continued. Aspiration of the chest produced 1 pint (570 ml.) of greenish fluid, which contained 8,730 white cells per c.mm. These were predominantly lymphocytes and the fluid was sterile. No tubercle bacilli grew on culture. He was treated by repeated aspirations and air replacement of the effusion, the fluid becoming haemorrhagic and later pocketing at various levels. In May, 1946, he was found to have an opacity in the left mid-zone and a slight tender enlargement of the liver. After that he had further aspiration of fluid and prolonged rest in bed. The condition gradually improved. Sputum tests were persistently negative for tubercle bacilli, as was repeated fluid culture. In July he was transferred to another hospital; so before admission to Harefield he had spent periods in three hospitals, amounting to nine months.

On admission his general condition was good. He was afebrile. He had a slight cough, with a small quantity of frothy sputum but no pain (previously he had stabbing pain in the right side of his chest). There were no night sweats and no haemoptysis. Occasional attacks of asthma were relieved by ephedrine. He was gaining weight (he had lost 3 st. (19 kg.) during his illness). There was no diarrhoea and no history of pruritus or anal bleeding.

On examination pronounced wasting of the right side of the chest was seen with diminished movement and dullness over the right base and impairment of breath sounds in this area. Harsh rhonchi were heard over both lungs. There was nothing else of note apart from bilateral Dupuytren's contractures. A blood count showed: haemoglobin, 110%; red cells, 5,950,000; white cells, 9,800 (polymorphs 43%, eosinophils 30%, lymphocytes 21%, monocytes 6%). The B.S.R. was 10 mm. in one hour (Westergren).

On culture the sputum was repeatedly negative for tubercle bacilli.

A radiograph showed the heart and trachea to be displaced to the right. The appearance of the right lung suggested pleural effusion or residual pleural thickening, together with infiltration of the apex. The left lung seemed to be clear, the previous lesion having apparently resolved.

In view of the eosinophilia (30%) a specimen of stools was sent to the laboratory, which reported numerous *Strongyloides stercoralis* larvae in the specimen.

The patient continued to have frequent attacks of asthma, often twice daily, which were relieved by $\frac{1}{2}$ gr. (32 mg.) of ephedrine hydrochloride.

Attempts were made to clear the infestation by using gentian violet capsules (1½-hour coating) 1 g. three times daily half an hour before meals until 50 g. were given. In view of the pulmonary symptoms, intravenous gentian violet (15 ml. of a 0.5% solution) was injected on alternate days for a month. Both these courses were carried out simultaneously. They

were without effect on the clinical condition, and the larvae persisted in the stools. A second attempt was made with hexylresorcinol. The patient, who had been given a saline purgative the previous day, received 9 g. of the drug at 6 a.m. No food was given for five hours, and a saline purgative was administered 24 hours after the dose. Following this treatment the majority of larvae in the stools were dead and there was considerable difficulty in finding any living ones. During this period, which lasted ten days, the patient was free from attacks of asthma. A specimen of stools ten days after the dose had been given contained numerous living larvae and the asthmatic attacks returned at the same time.

On July 30 he was transferred to another hospital under the care of a specialist in tropical diseases, who again greatly reduced the number of larvae in the stools, this time with gentian violet treatment. There was a simultaneous improvement in his asthma during the period of reduction. It was considered that the asthma was definitely related to the *Strongyloides* infestation. During all this period the sputum was persistently negative for tubercle bacilli on concentration and culture, and *Strongyloides* larvae were not found in the sputum. The x-ray appearances had not changed since his admission to Harefield.

Discussion

Pulmonary changes associated with *Strongyloides stercoralis* infestation have been described by Lowe and Lancaster (1944) in their report on 16 cases of strongyloidiasis. Seven of their cases had pulmonary symptoms, four complained of unproductive cough for some weeks, one had been investigated for suspected pulmonary tuberculosis, and one had a small haemoptysis whilst under observation in hospital. Radiographic examination of four patients revealed increased bronchovascular markings. On no occasion had larvae been found in their sputum.

Gage (1911) reported a case in which there were signs of diffuse bronchitis and lobar pneumonia with *Strongyloides* larvae in the sputum. At post-mortem examination the diagnosis of *Strongyloides* pneumonitis was confirmed. Froes (1930) reported a case of pleural effusion in which rhabditiform larvae were discovered before death. Berk *et al.* (1943) describe two cases of strongyloidiasis with pulmonary symptoms. In both cases tuberculosis was suspected owing to cough and sputum, in one case blood-stained, and increased roentgenological markings. Both cases had pronounced eosinophilia. In neither case were larvae recovered from the sputum. In natives with *Strongyloides* infestation for long periods, De Langen and Lichenstein have reported severe asthmatic attacks.

In the case described above, pulmonary symptoms were produced by the infestation. The relationship of the asthma to those periods when living larvae were present in the stools in large numbers is worthy of note. In spite of improvement in the symptoms while under treatment with both hexylresorcinol and gentian violet there was failure to eradicate the infestation entirely.

The significance of the pleural effusion in April, 1946, is difficult to assess. There is no report of larvae in the fluid aspirated at that time, and in the cases of pleural effusion secondary to *Strongyloides* infestation previously reported larvae have been found in the effusion fluid.

I wish to express my thanks to Dr. K. R. Stokes, Medical Director, Harefield County Hospital, for permission to publish this paper; to Dr. John C. Roberts, physician to the Military Unit, Harefield, for advice and criticism and for his invaluable help at all times; and to Dr. F. E. T. Scott, who carried out the bacteriological investigations.

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A TIDAL-AIR WHISTLE

BY

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The main object of artificial respiration is to produce an adequate tidal air. This whistle, held in the subject's lips, makes his tidal air audible to the operator, the instructor, and the class.

Up till now the ritual of resuscitation has been performed with faith and hope but without evidence that its object was being achieved. Part of expiration might be heard; inspiration was never audible. An instructive instance occurred recently at a meeting held in Beverley before a doctor delegated by the Swiss Red Cross. When the operator, a man with ten years' experience, carried out Schäfer's method the whistle hardly sounded; but when he was replaced by a highly skilled operator it sounded for all to hear. Examiners armed with a whistle could find and remedy many defects.

The whistle is on the bird-call principle, because it must sound during inspiration as well as in expiration—an obvious need for the skylark. It can be boiled, and is easily washed (e.g., in "dettol") each time the subject is changed. It works when its interior is still wet. Counting in seconds—often incorrectly estimated—can now be discarded: timing is done by the whistle to suit the subject's physique. When the inspiratory sound ceases (not before) expiration is induced, and vice versa. If the whistle is obeyed, respirations will not be hurried or jerky. The classes become interesting, and are even amusing. Usually the timing coincides approximately with the orthodox 12 per minute of Schäfer and Silvester. In the rocking method, as it produces a greater tidal air, the longer, smoother whistles call out for a slower rate of about 9 per minute. This is also better for the circulation (4 seconds head-down; 3 seconds feet-down). Tests on larger numbers are needed.

The model has been found to work on all healthy adults and on children of 4–5 stone (25.5–32 kg.), rocked manually. The largest subject was a six-foot (1.8 m.) doctor with a 44-inch (1.12 m.) chest who was rocked for over five minutes, whistling loud and long. He said he was so comfortable that he nearly went to sleep. Yet, when doing his own breathing at rest, the 5-mm. aperture was only just adequate.

Dr. A. A. Harper, of the Physiology Laboratory of Manchester, kindly measured carefully the effect of the whistle in Schäfer's method in two subjects. He found it did not affect the volume of the air breathed, but of course it increased the resistance slightly. The figures were: inspiratory pressure increased from 3.6 to 7.2 cm. H₂O; expiratory increased from 2 to 4.1 cm. H₂O. He considers that these resistances would be of no importance in training conscious subjects. He also allows me to adopt the very convenient nose-clip he used.

Professor E. A. Pask, of the Newcastle Department of Anaesthesia, was good enough to measure the sensitivity of the whistle. With a respiration pump it was just audible at a tidal volume of 200 c.cm. at 8 respirations a minute with a rate of flow of 3.6 litres a minute; or, with a steady flow of oxygen, at 4 litres a minute. He considers it "an instrument of remarkable sensitivity which will be of considerable use in training." In Dr. Harper's subjects the volumes per minute ranged from 6.6 to 7.8 litres with the whistle in Schäfer's method. I am told that the inspiratory note is upper B flat, and expiration usually an octave lower.