Radiographs showed that the chest opacity had very considerably increased in the past three months, but bronchoscopy remained negative. On March 11 a left pneumonectomy was carried out by Mr. Vernon Thompson. The growth, which was in the hilar region, was massive, but no enlarged mediastinal glands were found, and there was no growth in several hilar glands later sectioned. The tumour was a squamous-celled carcinoma. Convalescence was again uneventful, but in view of the dural adhesions the patient was referred to Dr. Frank Ellis for deep x-irradiation of the region of the cranial defect. No radiation was given to the chest.

At the time of writing, 18 months after the removal of his lung, the patient is well, works a full day in his exacting employment, and has no sign of recurrence or of any further metastasis.

I am indebted to Mr. D. W. C. Northfield and to Mr. Vernon Thompson for permission to publish this case history; and to Professor Dorothy Russell and Dr. W. W. Woods for their kind assistance.

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HUMAN INFESTATION WITH TRICHO-STRONGYLUS IN SOUTH PERSIA

BY

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An investigation of the worm infestation of the labourers employed by the Anglo-Iranian Oil Company at their refinery at Abadan was undertaken in January, 1947. These men numbered 30,000, and from the routine investigations made in the company's pathological laboratories it was believed that about one-quarter of them harboured hookworm and about one-sixth of them *Ascaris*. *Trichuris*, *Enterobius*, and *Hymenolepis* were known to be much less frequent.

Abadan Island is mainly arid desert, except for a belt of date palms at its margin and in the residential areas close to the refinery, where abundant irrigation by pumped river water is available. For most of the year the climate is extremely hot and dry, the rainfall occurring only in the cool winter months. The refinery area is furnished with metalled roads, and the labourers wear shoes except when in their own homes. The conditions therefore are the very reverse of those in which ankylostomiasis would be frequent.

"Ground itch" around the ankles is not seen, grave anaemia is infrequent, and attempts to dislodge the worms by means of such drugs as carbon tetrachloride and tetrachlorethylene had been consistently unsuccessful. One notable case was that of a British medical officer who had passed ova for five years in spite of the use of all known treatments and who had remained in excellent health except when enduring the discomforts of purgation.

Present Investigation

Technique of Laboratory Investigation.—(1) A fragment of freshly passed faeces was emulsified in saline on a slide, and a cover-slip applied. (2) A considerable quantity of

faeces was intimately mixed with saturated sodium chloride solution in a test-tube, filled to the brim, and a slide placed in contact with the upper surface of the fluid. After 30 minutes the slide was removed and a cover-slip placed on the adherent fluid.

Altogether 1,000 specimens were examined. During the examination it became evident that two distinct eggs were being diagnosed as those of hookworm. In the accompanying Table these are quoted together as "hookworm."

Parasite	In Direct Film	In Flotation	In Direct Film Only	Total Reported
"Hookworm" ..	278	675	20	695
<i>Ascaris lumbricoides</i> ..	162	211	55	266
<i>Trichuris trichiura</i> ..	25	74	13	87
<i>Hymenolepis nana</i> ..	8	17	3	20
Double infestation ..	—	—	—	229
Treble infestation ..	—	—	—	21
No infestation ..	—	—	—	173

Enterobius vermicularis was not seen in this series, and is distinctly rare. The ova were reported only 10 times in 19,000 routine specimens in the year 1948, but no special methods such as anal scraping were employed. Similarly *Taenia saginata* was not encountered, but it is fairly frequent, ova or segments having been found 144 times in the same series of 19,000. *Taenia solium* is unknown, but is not to be expected among a people whose religion forbids the eating of pork.

The differences noted between these two "hookworm" ova before the identity of both was established were as follows: One was the characteristic *Ancylostoma* egg with rounded ends, one, two, or four blastomeres, and an opalescent appearance. The other was somewhat larger, always showed advanced segmentation, and had one end rounded and the other slightly pointed. It lacked the opalescent appearance of true hookworm and was much more clearly visible under the low-power objective of the microscope.

Once the distinction was established, the number of each appearing in the second 500 specimens was recorded and found to be 16 of the true hookworm and 324 of the false. This agrees fairly well with the figures recorded for the year 1948, when all the technicians were familiar with the two types: 67 cases of true hookworm were reported and 1,671 of its imitator.

Craig and Faust (1945) describe *Trichostrongylus* as a very frequent parasite of sheep and goats. Thirty samples of faeces were therefore collected from sheep intestines obtained from the local slaughterhouse and ova identical with those found in human faeces were observed in all of them. In addition adult worms were discovered in five of the sheep.

The adult worms have not been found in man. The population is overwhelmingly Moslem and the strongest objection is made to necropsies. Consequently only an occasional medico-legal necropsy is done, and, although a search is made for *Trichostrongylus* on each occasion, this has so far yielded no results and the species remains unidentified. Five patients were admitted to hospital and treated with a succession of anthelmintic drugs, but no worms were found in the stools and the men all continued to pass ova. This is in accordance with Mapstone's (1941) statement that no effective means of eradicating the worms is known.

Although final and complete proof that this second parasite was *Trichostrongylus* had not been obtained, as the adult worms had not been isolated, the parasite was assumed to be of this genus for the following reasons: (1) The climate is not one in which the life cycle of *Ancylostoma* could favourably be completed; (2) the wearing of shoes

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