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A Colour Atlas of Clinical Parasitology

Tomio Yamaguchi

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*1. Clinical parasitology
Atlas*

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Preface

It is difficult to deal fully with the problem of parasitic infection without an understanding of complicated host-parasite relationships including, for example, zoonoses and visceral larva migrans.

Parasitologists are now being more frequently consulted about the diagnosis of cases showing eosinophilia of unknown aetiology, discharged or excised parasites, fragments in pathological specimens and eosinophilic granulomata. Consequently parasitic diseases are now thought to be increasing.

Moreover, tropical diseases are being imported more frequently as more people travel widely in tropical areas and either enter or return to their own country. Because the majority of tropical diseases entail parasitic problems, practising clinicians have become increasingly involved in dealing with problems which require a knowledge of parasitic diseases. In addition, the increasing popularity of pets and greater diversity of foods have often led to infection and the outbreak of unexpected parasitic diseases. It also happens that efforts to restore environments which have been destroyed are often accompanied by

the recurrence of certain diseases. In Japan an increasing incidence of toxoplasmosis, metagonimiasis and diphyllorhynchiasis, epidemics of trichinosis and a revival of tsutsugamushi disease have been reported. Increasing numbers of medically important insects such as lice, fleas and bedbugs have also been reported.

In view of the above facts, it is now essential to consolidate and extend our knowledge of parasitic diseases and prepare to cope with new problems. This book covers important parasitic diseases in Japan and also those of tropical areas. The description, as a rule, is arranged according to the symptoms and is based on enumerated parasitic diseases.

It is, therefore, hoped that the atlas will prove useful not only to parasitologists but also to clinicians, medical schools and medical laboratories for diagnostic work, in the laboratory, in clinical practices and in teaching activities.

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COLOUR ATLAS OF CLINICAL PARASITOLOGY



1 Respiratory symptoms

A Protozoal

1 Amoebic pulmonary abscess

In tropical areas an amoebic pulmonary abscess is present in 1 to 4 per cent of amoebic dysentery cases. However, the main route of infection is not primarily haematogenous or lymphogenous but is transferred from an amoebic liver abscess. This amoebic complication usually results from direct extension or rupture of the amoebic liver abscess, that is, when the amoebic abscess ruptures, trophozoites of amoeba invade the lung through the diaphragm and then the pleural surface. In the case of amoebic pulmonary abscess, patients usually complain of dyspnoea, chest pain, cough, mild to moderate fever and hepatomegaly without sputum. When the abscess ruptures into the bronchus, however, pale reddish-yellow sputum may appear. The amoebic pulmonary abscess is usually in the right lung.

2 Kala-azar

Kala-azar is caused by *Leishmania donovani* and is transmitted by *Phlebotomus* spp. (sandfly). The liver, spleen and bone marrow are the main infected organs, and less commonly bronchopneumonia is seen.

3 Toxoplasmosis

Toxoplasmosis often appears in the congenital form as pneumonia, and also in the acquired form shows

atypical pneumonia with myocarditis, meningoencephalitis and hepatitis.

4 *Pneumocystis carinii* pneumonia

Pneumocystis carinii produces a diffuse interstitial pneumonia in infants and children with altered host resistance due to prematurity or debilitating disease. This is called 'interstitial plasmacell pneumonia' because of the interstitial hyperplasia and specific infiltration of plasmacells. Recently, however, the disease has tended to occur more often in individuals with congenital or acquired immunodeficiency disease. Especially, it occurs in increasing numbers, in patients receiving massive doses of anticancer drugs, antibiotics and anti-immune drugs against leukaemia, malignant lymphoma and various cancers of internal organs. Moreover, the prevalence and advance of immunosuppressive therapy after transplantation have resulted in many cases with this disease. Consequently this disease develops in both children and adults, and the host reaction does not usually show pathological changes such as interstitial hyperplasia and plasmacell infiltration. Therefore, it is not appropriate to call this condition 'interstitial plasmacell pneumonia'.

Early detection and adequate chemotherapy are very important in the control of *P. carinii* pneumonia. It is usually fatal unless treated. Lung biopsy material, sputum and pleural fluid must be examined with histopathological and smear preparations using Giemsa, toluidine blue 0 and methenamine-silver stains.

1 Acute toxoplasmosis. 58-year-old woman. Lymph nodes in neck, nape and submandible are enlarged; X-ray film of the chest indicates homogeneous shadow in both lung fields. Indirect haemagglutination and dye tests for toxoplasmosis were significantly positive, 1:8192 and 1:64, respectively. *Toxoplasma gondii* was isolated from mice inoculated with whole blood of the patient. The symptoms improved following treatment with pyrimethamine and sulfa drug.

2 Acute toxoplasmosis. 60-year-old woman. The patient died of complicated pneumonia during treatment for chronic lymphatic leukaemia (T-cell leukaemia). X-ray film of the chest before death shows homogeneous shadow in both lung fields, especially the left. Histologically, it appears similar to *Pneumocystis* pneumonia.

3 Toxoplasmosis. Proliferation of trophozoites (tachyzoites) of *T. gondii* is seen in reticuloendothelial cells of alveolar wall and interstitium of the lung; also numerous in the tissues. Giemsa stain.

4 Toxoplasmosis. Magnification of 3.

5 *Pneumocystis carinii* pneumonia. 55-year-old woman. Died of complicated pneumonia, during treatment with corticosteroids for systemic lupus erythematosus (SLE). Homogeneous increase in density in both, especially the left, lung fields.

6 *P. carinii* pneumonia. 33-year-old man. Died of complicated pneumonia during treatment with 6-MP and steroids for chronic lymphatic leukaemia. X-ray film of the chest indicates dense shadow in entire field.

7 *P. carinii* pneumonia. 8 years and 8 months old boy. Onset during chemotherapy for acute myeloid leukaemia (AML). X-ray film of the chest shows diffuse and veiling shadow in entire field.

8 *P. carinii* pneumonia. Twelve days after combination therapy with pyrimethamine (50 mg/day) and sulfa monomethoxine (1 g/day) given orally for 14 days. X-ray film of the chest indicates marked improvement (7 case).

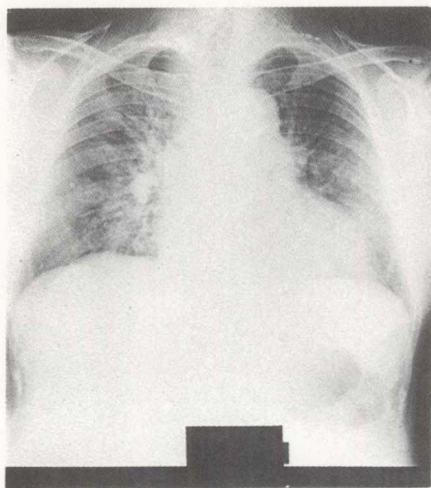
9 The lung of *P. carinii* pneumonia. 34-year-old man. The lung is enlarged, heavy and firm, and like liver in appearance. 20 670 000 cysts were detected from 1 g of the lung by cyst concentration technique.

10 Cysts of *P. carinii*. Smear preparation of lung biopsy material; crowded cysts; toluidine blue 0 stain ($\times 1000$).

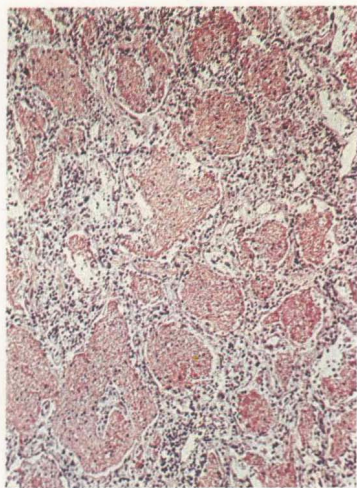
11 *P. carinii* pneumonia. The alveoli are packed with foamy material and there is thickening of alveolar septa.

12 *P. carinii* pneumonia. 33-year-old man. Died of acute lymphatic leukaemia complicated with pneumonia. Histologically, *P. carinii* combined with cytomegalic inclusion virus. A: exudate caused by *P. carinii*; B: crowds of virus in the nuclei of hyperplastic alveolar epithelial cells; C: increased virus in the cytoplasm.

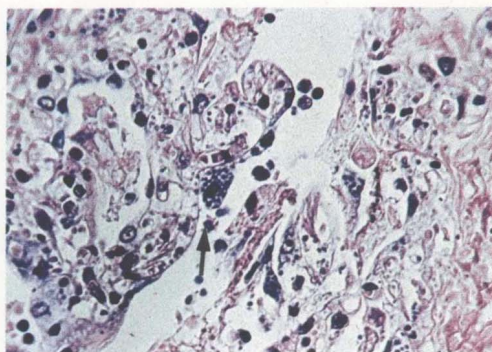
13 *P. carinii* pneumonia. Magnification of honeycombed foamy material in the alveoli. It is impossible to detect the cysts by haematoxylin-eosin stain ($\times 1600$).



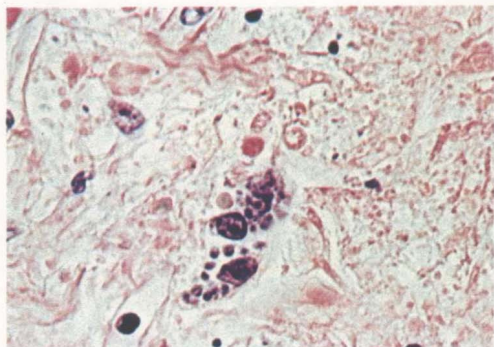
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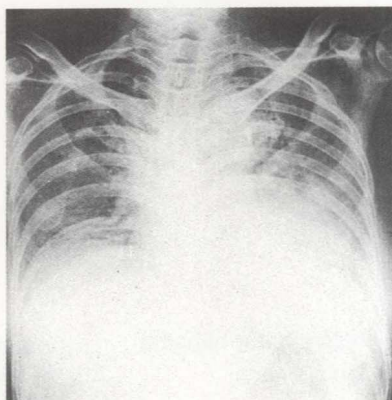
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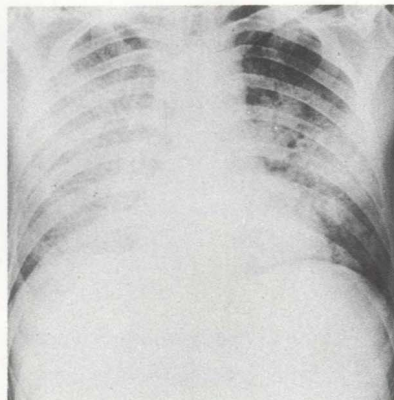
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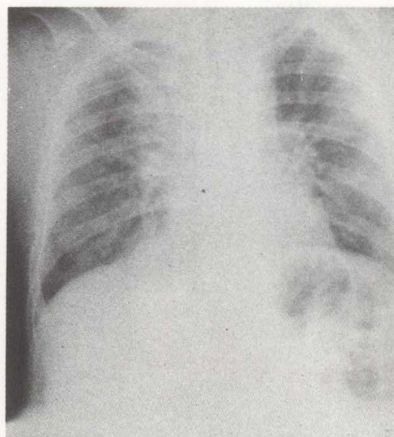
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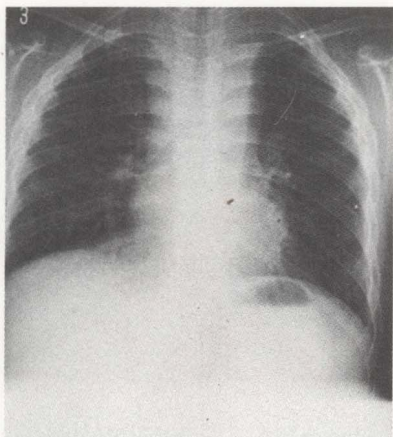
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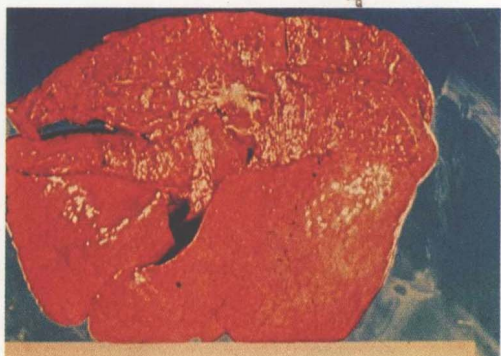
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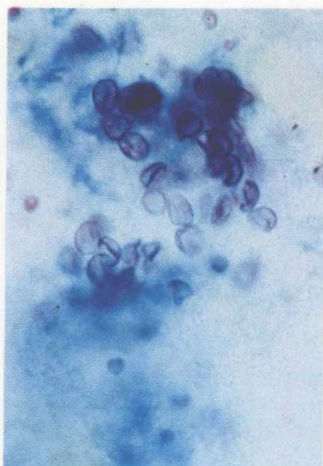
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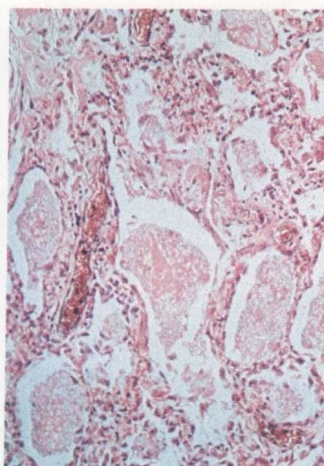
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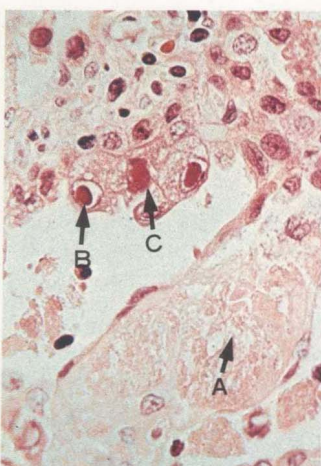
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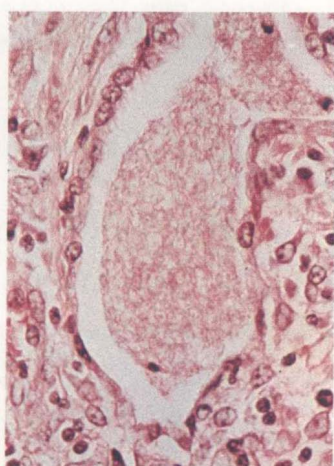
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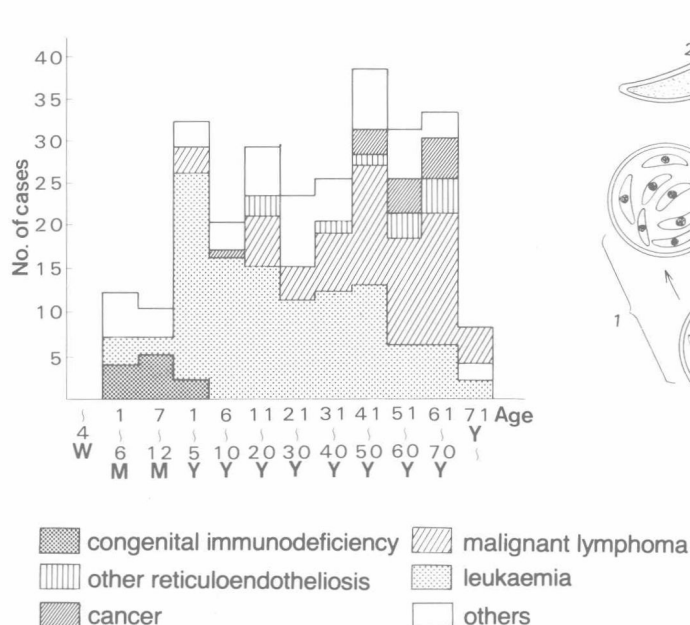


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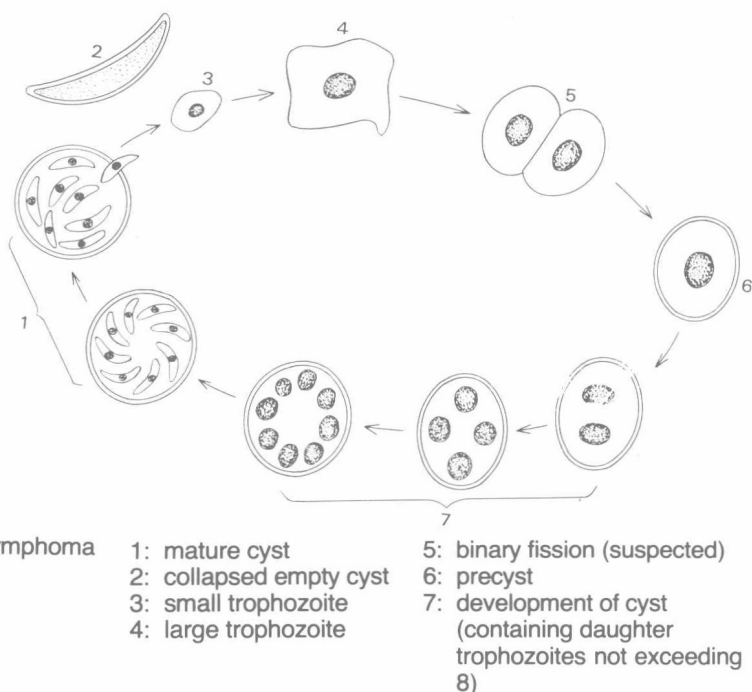
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Severe infectious diseases, caused by the failure of immunomechanisms with prolonged and massive administration of immunosuppressive and anticancer drugs, are now increasing. As toxoplasmosis and *Pneumocystis carinii* pneumonia are opportunistic parasitic diseases special attention has to be paid to the outbreak of these diseases in the future.



14 *P. carinii* pneumonia cases in Japan. Classified by age and basic disease (260 cases reported during 1967 and 1977 in Japan).

Congenital immunological incompetence is important in those under 1 year of age; leukaemia in the 1–10 year age group; malignant lymphoma and



15 Proposed life cycle of *P. carinii* (from Vanek and Jirovec).

cancer of internal organs in those above 10 years of age. Pneumonia occurs frequently in both younger and older age groups.

16 Cysts of *P. carinii*. Cyst wall is black with Gomori's methenamine-silver stain (modified Grocott's technique).

17 Cysts of *P. carinii*. Numerous cysts stained blackish-brown are seen in the exudate of alveoli (Grocott's stain, 6 case).

18 Cysts of *P. carinii*. Touch preparation from cut surface of the lung, a comparison in size between cysts and erythrocytes.

19 Cysts of *P. carinii*. Section of the lung with toluidine blue O stain. Cyst wall stained purple. This staining technique is simpler and more rapid than methenamine-silver.

20 Cysts of *P. carinii*. Smear of the lung with Giemsa stain. Matured cysts (containing 8 trophozoites), immature cyst (containing less than 8 trophozoites) and free trophozoite (with one nucleus) state are seen.

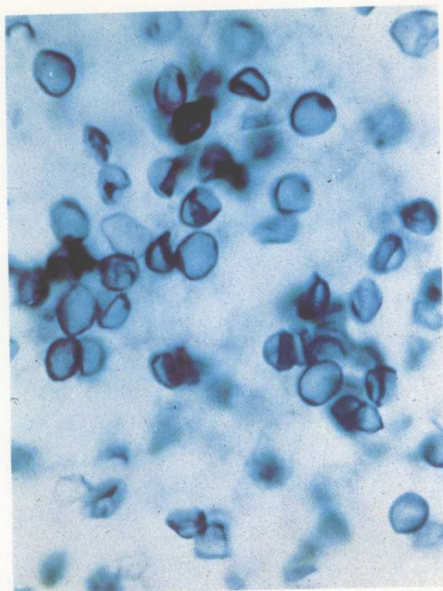
21 Cyst of *P. carinii*. Smear of the lung with Giemsa stain. Cyst containing typical 8 trophozoites. Giemsa stained

impression smear is the best method for observation of trophozoites.

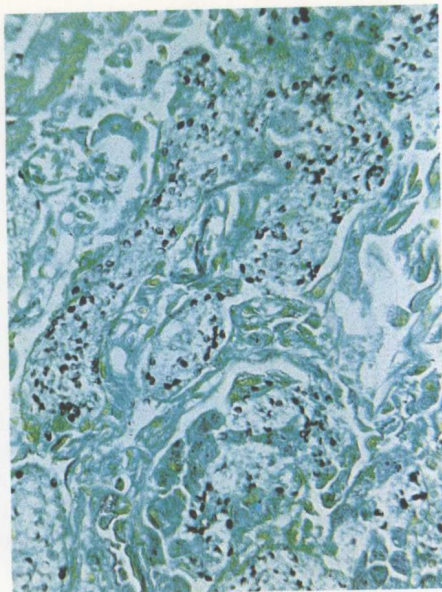
22 Ultrastructure of *P. carinii* cyst. Cysts were obtained from the lungs of rats by a concentration technique. Cyst is 3.7 μm in diameter, and contains 5 trophozoites each with nuclei; cyst wall is thick and consists of 3 layers each 900–1200 \AA thick.

23 Ultrastructure of *P. carinii* trophozoite. Three trophozoites (T) are seen on the surface of alveolar epithelium (E) from experimentally proliferated rat lung. The trophozoites adhere closely to the epithelial cell and are 3.5–4 μm in diameter and their pellicle is 300 \AA thick. They have one nucleus in each and nucleoli are seen inside the nuclei.

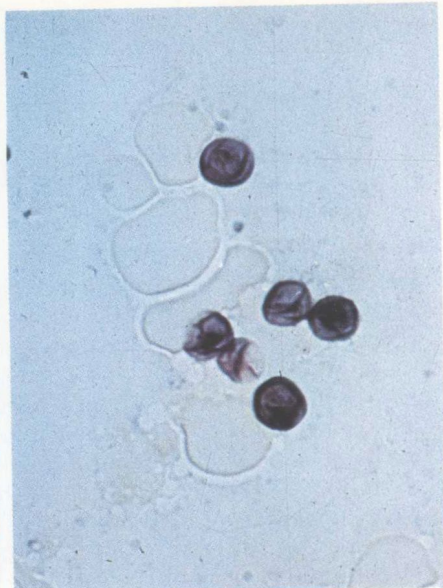
24 Ultrastructure of excysted *P. carinii*. After the trophozoites excyst, cyst wall collapses and caves in to a crescent shape; cyst 4 μm in length without distinct organelles. The remaining cyst is encapsulated and contracted in size.



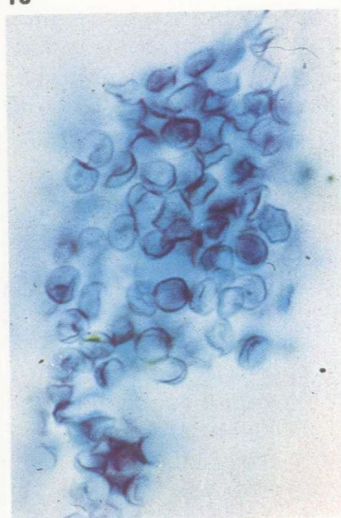
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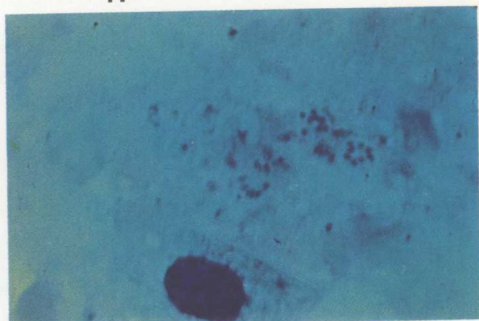
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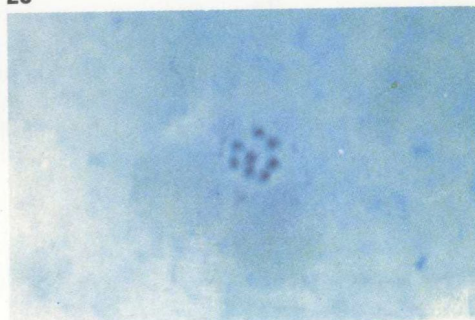
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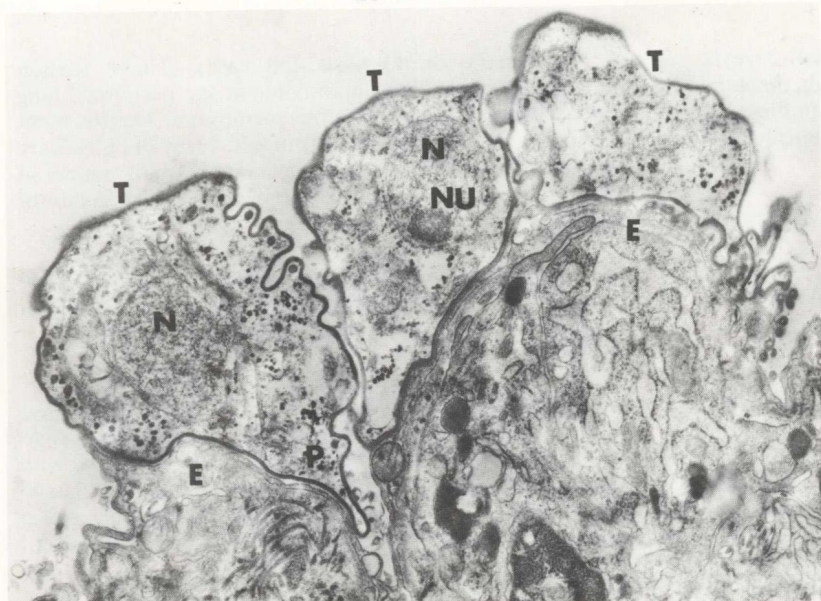
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B Helminthic

1 Ascarid pneumonitis (pulmonary ascariasis)

If large numbers of infective eggs are ingested, the larvae may cause intensive tissue reactions in the lung associated with dyspnoea often of the asthma type, fever, cough, rales. X-ray shows infiltrative shadow suggestive of pulmonary tuberculosis or viral pneumonia. Eosinophilia during this phase is prominent. The sputum characteristically contains many eosinophils and at times abundant Charcot-Leyden crystals. Although ascarid pneumonitis has its onset suddenly and causes severe symptoms, it is characteristic in clearing up spontaneously within 1 to 2 weeks (Loeffler's syndrome).

2 Toxocariasis (toxocarosis)

If the larvae of *Toxocara* spp. especially *T. canis* larvae invade young children, the larvae migrate into the liver and central nervous system (visceral larva migrans) causing hypereosinophilia. At times it causes moderate pulmonary infiltration, fever, cough and asthma type attacks.

3 Hookworm disease

The larvae of *Necator americanus* migrate predominantly percutaneously and when massive may cause transient bronchial pneumonitis (Loeffler's syndrome). However, *Ancylostoma duodenale* in Japan is described as causing a pharyngeal itchy

sensation, cough, dyspnoea, eosinophilia and frequently nausea and vomiting, one to several days after ingestion of larvae on fresh-picked young greens. This condition is known as 'Wakana disease'.

4 Pulmonary dirofilariasis

Dirofilaria immitis, the heartworm of dogs, lives in the chambers and connecting large vessels of the right heart, and is transmitted by mosquitoes. Recently, an increasing number of cases of human infestation have been found. Most parasites are located in the lungs and superficial soft tissues. In the lungs, the disease is diagnosed as tuberculosis or carcinoma, and the diagnosis is usually confirmed by surgical specimens.

5 Strongyloidiasis

There may be pneumonitis during larval migration (Loeffler's syndrome). Autoinfection is common and must be watched for. Occasionally, the larvae are found in pericardial fluid, pleural fluid, ascites and urine, and cause bronchial pneumonitis.

6 Tropical eosinophilia (tropical pulmonary eosinophilia; eosinophilic lung; Weingarten's syndrome)

The condition is mainly found in tropical and subtropical areas. There is hypereosinophilia of the blood, with cough and asthmatic breathing or dyspnoea which are more marked at night. X-ray finding of the chest is mostly abnormal.

25 Pneumonitis due to *Toxocara canis* infection. 3 years and 4 months old boy. The patient had cough, hepatosplenomegaly and rash in upper and lower extremities and face with eosinophilia. X-ray film of the chest indicates the shadow especially in the right lung field.

26 Adult *Dirofilaria immitis*. From the heart of a naturally infected dog, male (upper); female (below).

27 Adult *D. immitis*. From a naturally infected dog.

28 Microfilaria of *D. immitis*. Giemsa stain.

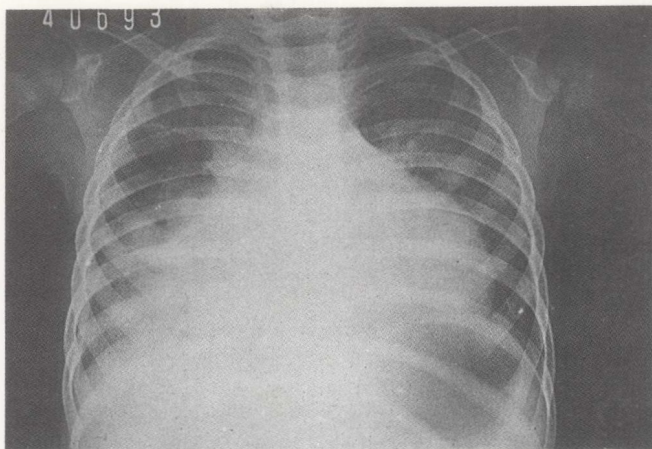
29 Microfilaria of *D. immitis* in the blood vessels of the liver.

30 Pulmonary dirofilariasis. 57-year-old man. Admitted to hospital with complaints of cough and severe intrathoracic pain; 2 numular lesions were seen on X-ray in the right lower lung field. They were excised as benign tumours. The tumours are encapsulated with thin membrane and coagulative necrosis is seen at the centre of the lung tissue.

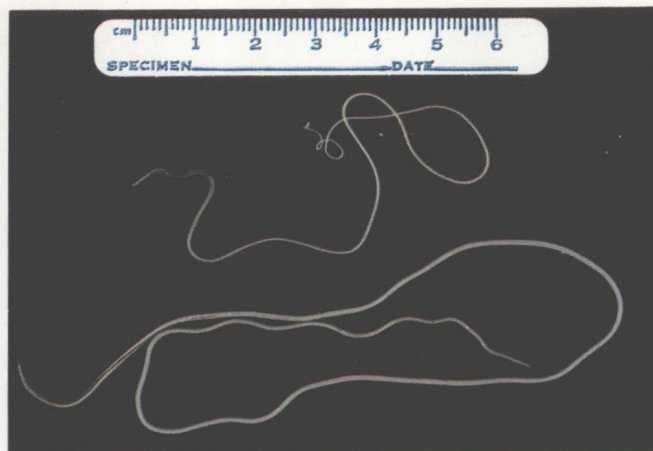
31 Pulmonary dirofilariasis (30 case). Tissue section showing sharp bordered granuloma at the peripheral lung tissue with inflammatory fibrous membrane. The fragment of worm is seen in the necrotic embolic tissue of pulmonary arterioles. Eosinophils, lymphocytes and a small number of foreign body giant cells are seen around the focus of necrosis.

32 Vascular infarction due to *D. immitis*. 79-year-old man. A small finger-tip sized tumour was excised from the right lower lung lobe during operation for oesophageal carcinoma.

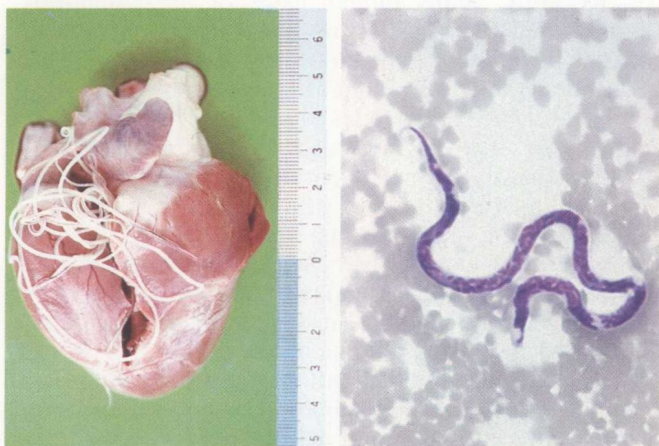
33 Pulmonary dirofilariasis. 48-year-old man. A localised and roundish shadow was found in the left lower lung field by X-ray. Lobectomy of the left lung was performed with preoperative diagnosis of tuberculosis or tumour. Tissue section shows haemorrhagic exudative pneumonia and a fragment of *D. immitis* is seen in the pulmonary arteries of the focus.



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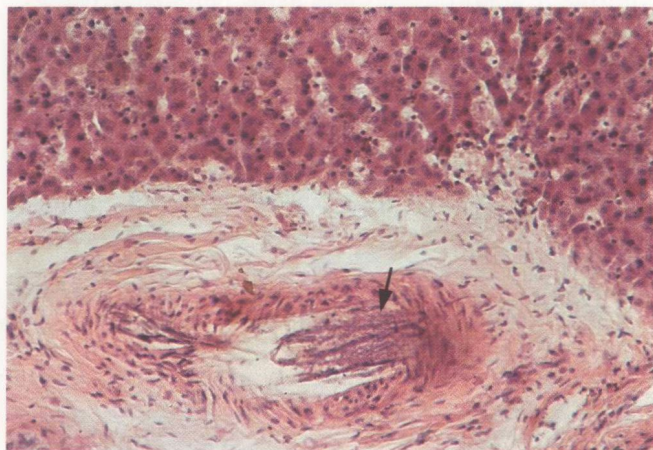


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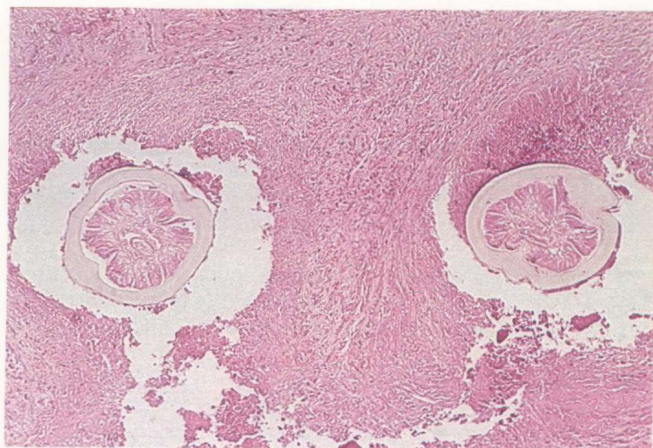
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7 Paragonimiasis (pulmonary distomiasis; endemic haemoptysis; oriental lung fluke disease; paragonimiasis *westermani*)

Paragonimiasis is one of the important human parasitic diseases distributed world-wide in Japan, Asia, Africa and Central-South America. Paragonimiasis is usually acquired by the ingestion of encysted metacercaria contained in fresh-water crabs and crayfish which are the second intermediate hosts.

Human paragonimiasis in Japan is largely due to *Paragonimus westermani*. The adult worm resides normally in fibrous capsules in the pulmonary parenchyma, and the parasite produces a surrounding 'tubercular' cyst. The cyst consists of fibrous granulo-loma and has evident new growth of small vessels, infiltration of eosinophils and plasmacells. Many eosinophils, neutrophilic leucocytes, histiocytes, and at times Charcot-Leyden crystals are seen inside the cyst. The nodular formation caused by accumulated epithelioid cells seen around the cyst wall is remarkably similar to those of epithelioid cell tubercles in tuberculosis. Foreign body giant and Langhans' giant cells are often present close to the peripheral area of cyst and eggs.

In the lung tissue acute, subacute or haemorrhagic pneumonitis are mainly recognised, and at times proliferative interstitial pneumonia or pulmonary cirrhosis is seen in the peripheral area of the cavity.

The chief sign of paragonimiasis is haemoptysis and so the patient usually visits the doctor with blood-tinged sputum. The characteristic sputum after

coughing spells is thick and sticky, may be tinged light brown or chocolate brown from the presence of blood and parasite eggs, and is sometimes mixed with spotty or dotted haemorrhages. X-ray of many patients will show tuberculosis-like findings in the lungs, and it is necessary to differentiate paragonimiasis from other pulmonary diseases, especially tuberculosis, in endemic areas.

In paragonimiasis, numerous ectopic lesions are reported in the thoracic cavity, abdominal cavity, greater omentum, diaphragm, pericardium, liver, adrenal gland, scrotum, subcutaneous sites in the abdominal wall, hernia sac, brain, spinal cord, orbit and eyelid.

Recently, many human cases of paragonimiasis contracted by ingestion of sliced raw flesh of wild boars have been reported from Kyushu, Japan. This outbreak was caused by *Paragonimus metacercariae* migrating into the muscles of wild boar from the crab, and wild boar is regarded as a paratenic host. Consequently special attention must be paid to the ingestion of raw meat of wild animals in the future.

To make a diagnosis, the first step is to find out if the patient with pulmonary symptoms lives in an area where the disease is endemic, and if he has ingested crabs. Then carry out the intradermal test; if positive, proceed to the complement fixation test; if this is positive repeated examination of sputum and faeces, immunoserological examination such as gel diffusion precipitin test and immunoelectrophoresis are necessary.

For the treatment of paragonimiasis oral bithionol has definite helminthcidal effect on this worm.

34 **Adult *Paragonimus westermani*.** Lung of a dog 5 months after experimental infection.

35 **Adult *P. westermani*.** Lung of a dog 60 days after experimental infection with 25 encysted metacercariae. Congestion or haemorrhage is seen in the periphery of cyst.

36 **Section of lung.** Cross-section of *P. westermani* lying inside a cavity with thick fibrous capsule and containing 2 parasites.

37 **Adult *P. westermani*.** The parasites are fleshy worms with convex surfaces.

38 **Adult *P. westermani*.** Living worms just after excision are pinkish in colour; it is possible to look through the interior of the body. Body is thick, measuring 10 mm in length, 5 mm in breadth and 5 mm in thickness.

39 **Adult *P. westermani*.** Flattened and stained specimen. Obtained from a dog infected with metacercariae collected from fresh-water crab, *Eliocheir japonicus*, Ehime, Japan.

40 **Adult *P. westermani*.** Flattened and stained specimen. Obtained from a dog infected with metacercariae collected from fresh-water crab, *Potamon dehaani*, Akita, Japan.