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TOXOPLASMOSIS IN DOMESTIC ANIMALS:

Canine Toxoplasmosis Associated with Distemper[1]

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ABSTRACT

Three fatal cases of canine toxoplasmosis associated with distemper are reported. The intestinal ulcers in 2 cases are described as the primary sites of toxoplasma invasion by oral infection. The flare-up of latent toxoplasmosis is believed to be proved by distemper virus. The other case is believed to be terminated in primary parasitemia.

The lesion caused by acute toxoplasma infection was primarily a process of coagulation necrosis. This was accompained by deposition of fibrin without or with negligible cellular reaction. As a result characteristic foci of delimitted, pinkish, homogeneous coagulation necrosis of viscera were formed.

The giant cell pneumonia, demyelinating encephalitis and inclusion bodies related to canine distemper are also described. This is the first documented report of canine toxoplasmosis associated with distemper infection in Taiwan.

From the view point of zoonosis, the increasing importance of toxoplasmosis is undoubtedly now worldwide. Serological surveys indicated a high incidence of toxoplasma infection among dogs (1, 2, 3). The transmission of this malady between human beings and dogs have been suggested by some workers (1, 4, 5), but whether man and dog acquire toxoplasmosis from the same source or sources remains obscure (3).

Since swine toxoplasmosis was reported on Taiwan by Pan *et al.* (6) in 1961, many additional swine cases have been found everywhere on this island. However, canine toxoplasmosis has not been reported in Taiwan yet. The present paper deals with the observation on 3 fatal cases of canine toxoplasmosis complicated with distemper found in Taiwan.

MATERIALS AND METHODS

The cases submitted for necropsy were from local veterinary clinics. These dogs were diagnosed as suffering from canine distemper, based on clinical findings. On necropsy, tissues were removed and fixed in 10% aqueous formalin. Paraffin blocks were cut in 6 μ thick, and stained with hematoxylin and eosin. Pollak trichrome and Lendrum's stains (7) were used for staining fibrin.

Air dried touch preparations of lungs were fixed with methanol before staining. Giemsa, Wright and Pollak trichrome stains were used for demonstrating *Toxoplasma* and inclusion bodies of canine distemper.

A 10% suspension of ground lung tissue in normal saline was prepared with terramycin added to the final concentration of 3 mg/ml, and kept at room temperature for 30 minutes. Groups of 10 mice were used for each specimen, and each mouse received 0.5ml of inoculum intraperitoneal-

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ly. Paracentasis was frequently done from 6th day onward after inoculation to check the presence of *Toxoplasma.*

Toxoplasma was identified by morphological and serological findings as described previously (6).

RESULTS

Symptomatology and Pathology

Case 62-389

The animal was a male Spitz, aged 4 months, with clinical signs of slight coughing and mild elevation of body temperature. The animal apparently improved after a course of antibiotic and supportive treatments for one week, but his condition worsened at the 9th day when signs of high fever, anorexia, depression, occasional coughing, profuse nasal and ocular discharge, and nervous seizures developed. It died 16 days after the onset of first ill signs. Necropsy was conducted 8 hrs after death.

On necropsy, foot pads were slightly inereased in consistency. Large amount of yellowish mucopurulent ocular and nasal discharges were found. Several green-pea-sized necrotic areas were found at fundus and pylorus gland regions of the stomach. Occasional pin-head-sized petechiae and miliary-sized reddish erosive areas were found throughout the small intestine, especially duodenum. An ulcerated portion, about 1×0.5 cm in size, was observed in the colon. The liver was mottled with intervening yellowish and reddish areas. Irregularly shaped necrotic foci which were peach red-colored, from rice to green-pea-sized, were found here and there in the parenchyma. The slightly edematous gall bladder wall was about 1 mm thick. Reddened spleen abounded with miliary-sized whitish necrotic foci, and the white pulp was invisible. A few pin-head-sized whitish foci were noted in the cortex of kidneys, the medulla being slightly reddish. A small amount of whitish froth was found in upper trachea, and large amount of frothy mucus was found in the lower trachea, bifurcation of bronchi, and bronchioles. Well expanded, edematous and congested lungs gave semitransparent appearence. Minute grayish areas distributed evenly throughout the whole lung, particulary numerous at the periphery of the lung; these latter areas increased in consistency, but no consolidation was noted. Miliary to green-pea-sized grayish necrotic foci were frequently found in the cardiac muscle. All visceral and regional lymph nodes were slightly reddened and swollen. Cut surfaces of mesenteric and pulmonary lymph nodes were dry and gray. The thymus was edematous.

Numerous eosinophilic cytoplasmic inclusion bodies (*Fig. 1*) and *Toxoplasma* were found in the stamp smears of lung tissue, demonstrable with hematoxylin and eosin, Giemsa, Wright and Pollak trichrome stains.

Lung. Alveolar walls were markedly hyperemic. Diffuse and extensive alveolar edema with many septal cells, lymphocytes, and multinucleated giant cells were found in alveoli. Eosinophilic cytoplasmic inclusion bodies were frequently found in giant cells, septal cells and bronchiolar epithelial cells; scanty exudates were found in bronchioles. Frequent foci of coagulation necrosis, varying in size, scattered in the lung tissue, and the pinkish, homogeneous, amorphous alveolar contents (*Fig. 2*) were composed of necrotic cell debris and fibrin. Some of the necrotic process initiated from respiratory bronchioles, extending toward the nearby tissue. The cellular reaction in and around necrotic foci was meager. *Toxoplasma* grouped together in the cytoplasm of hypertrophic alveolar lining, septal and giant cells. In some alveoli, the former cells took adenomatous arrangement.

Cardiac muscle. Some microscopic-sized necrotic foci were found which contained a few extracellular toxoplasma organisms. The cellular reaction was absent in necrotic areas.

Liver. Numerous foci of coagulation necrosis with sharply defind margins scattered in acini without showing any particular pattern of distribution of lesions (*Fig. 3*). Fibrin was present in the necrotic areas. Kupffer cells engulfing numerous intensely blue materials, which were small and spherical, as well as toxoplasma organisms in their cytoplasm were found in or at the vicinity of necrotic foci. Occasional granulomatous foci, mainly composed of reticular cells and fibroblasts, were found in portal areas.

Stomach. Numerous eosinophilic inclusion bodies disseminated in chief and parietal cells of the mucosa (*Fig. 4*). A focal leision of coagulation necrosis of mucosa and submucosa was found in the pylorus gland portion, but no *Toxoplasma* was found here.

Large intestine. The ulceration process was deep down to the serosa and the adjoining adipose tissue; all layers were heavily infiltrated with mononuclears and neutrophils. The necrotic process of muscular coat extended diffusely toward the adjacent portion without mucosal involvement (*Fig. 5*). Numerous groups of toxoplasma organisms were found in macrophages and smooth muscle fibers (*Fig. 6*).

Kidney. Extensive degeneration of renal tubules with coarsely granular and deeply eosinophilic cytoplasm was found; some of which

were fragmented and some were missing nuclei. One wedge-shaped, eosinophilic, amorphous area of coagulation necrosis which contained some free extracellular toxoplasma organisms were found. Enlarged glomerular tufts almost filled the Bowman's space. Many eosinophilic cytoplasmic inclusions were found in the epithelial cells of renal calyx.

Spleen. Foci of coagulation necrosis which contained some fibrin were seen here and there in the red pulp. Lymph follicles were atrophic, and small numbers of lymphocytic cells remained around the central arteries; the marginal areas were replaced by mildly hyperplastic RE cells. Foci of necrobiotic and necrotic lymphocytic cells were seen within the follicles which contained fibrin. A few *Toxoplasma* and many eosinophilic intranuclear inclusion bodies were found in reticular cells in the follicles (*Fig. 7*).

Pancreas. A few eosinophilic intranuclear inclusion bodies were found in acinar cells (*Fig. 8*).

Lymph nodes. Extensive coagulation necrosis appeared in mesenteric and pulmonary hilar lymph nodes (*Fig. 9*); necrotic areas were constituted of homogeneous, pinkish material in which fibrin was occasionally present. The necrotic process extended to the capsule and its adjoining adipose tissue in which moderate mononuclear and mild neutrophilic infiltrations were found. A few toxoplasma organisms were found in macrophages in the adipose tissue. Some of the remaining lymphoid tissues showed hyperplastic plasma cells. In mandibular lymph nodes, many tiny focal necrotic lesions were present which contained a few proliferating toxoplasma organisms in macrophages. RE cells were moderately mobilized, and many of which showed mitotic figures.

Central nervous system. Several pinkish foci of necrosis were found in the nerve root at the base of medulla oblongata and in the cerebral cortex of the frontal and occipital lobes (*Fig. 10*). Many extracellular toxoplasma organisms were seen in these necrotic areas, and groups of proliferating organisms were also found within dead nerve cells and glial cells at the margin of necrotic foci (*Fig. 11*) and around the capillaries (*Fig. 12*). Acute swelling of nerve cells were frequently noted everywhere. The spinal cord was free from lesions. No demyelinating encephalitis was demonstrable in this case.

Case 61-106

A female Dalmatian, 4.5 months of age, was sick for about a week. High fever (40 C), vomitting, loose bloody stool and prominent mucopurulent nasal discharge were the main clinical signs.

On necropsy, one button-shaped old ulcer 2 cm in diameter was seen in jejunum. A small amount of tarry content was present in lower small intestines and cecum. The liver was pale-tan in color. One third of the outer margin of all pulmonary lobes were dull red in color and splenic in consistency, while the rest of lungs was paler than normal. On dissection, creamy exudates oozed out from the cut surfaces.

Lung. Alveoli were moderately dilated and alveolar walls thickened, on which attached many spindle-shaped giant cells which contained eosinophilic cytoplasmic inclusion bodies. Foci of pinkish, homogeneous coagulation necrosis without cellular reaction scattered in the lung tissue (*Fig. 13*). A considerable amount of fibrin existed in the necrotic foci. In some alveoli, hyperplastic alveolar lining cells showed adenomatous arrangement (*Fig. 14*). Many septal cells detached in alveolar sacs in which groups of proliferating *Toxoplasma* and eosinophilic cytoplasmic inclusion bodies were frequently seen. The latter were present in a few septal cells *in situ* also (*Fig. 15*). Neutrophils usually predominated in the exudate in alveoli, and most bronchioles contained numerous neutrophils, septal cells and detached bronchiolar epithelial cells. Venous thrombosis was frequently encountered.

Liver. Numerous tiny pinkish, homogeneous, sharply delimitted foci of coagulation necrosis scattered without special location of lesions in acini. A considerable amount of fibrin existed in the necrotic areas. No cellular reaction was noted in or around the necrotic foci. Occasionally, groups of *Toxoplasma* were found in the hepatic cells, either around or in the necrotic foci; some were found in Kupffer cells. Sinusoids were slightly dilated, and Kupffer cells engulfing hemosiderin were also noted. A moderate bile retention was seen in bile canaliculi. Occasional venous thrombosis, and moderately edematous Disse's space were observed.

Jejunum. Ulceration process reached the outer layer of smooth muscle just beneath the serosa, and in necrotized muscular bundles were found numerous neutrophils and toxoplasma organisms.

Kidney and urinary bladder. Intertubular connective tissue was slightly edematous. Many epithelial cells containing eosinophilic, cytoplasmic inclusion bodies were found in the transitional epithelium of the urinary bladder.

Spleen. Tiny necrotic or necrobiotic foci were seen here and there in the white pulp, while similar changes were relatively few in the

red pulp. Occasional proliferation groups of toxoplasma organisms were found in RE cells in the red pulp. A few intranuclear inclusion bodies were found in reticular cells of affected lymph follicles.

Lymph nodes. Extensive coagulation necrosis without cellular reaction was noted. All cellular elements appeared pinkish and homogenous but larger blood vessels were comparatively well preserved. Capsules were necrotized also. Many toxoplasma organisms were found in necrotic foci.

Central nervous system. Frequent glial nodules, mostly composed of microglias and astrocytes were found in midbrain, cerebellum and medulla oblongata. Occasional acute swelling of nerve cells was also observed. One toxoplasma cyst was found close by a glial nodule in the midbrain (*Fig. 16*). A few small demyelinating areas, composed of punched out nerve fiber-*Status spongiosus*—was found in the folia of cerebellar subcortical white mater (*Fig. 17, 18*), which showed moderate microglial and gemestocytic infiltration; many eosinophilic intranuclear inclusion bodies were demonstrable in glia cells. (*Fig. 18*).

Case 62-305

The dog was a male crossbreed, aged 1.5 years. The animal had been sick for over one month. The major clinical signs were high fever (40 C), dry cough and anorexia. Foot pads were harder than normal, and the hind quarter was found weakened for two weeks. The dog was necropsied 28 hrs after death.

On necropsy, abundant mucopurulent ocular discharge and slightly reddened conjunctivae were noted. Numerous tiny, grayish foci were found in the liver parenchyma. Large amount of foamy froth was present in the trachea, and lungs were moderately congested. Several grayish necrotic foci, rice to bean-sized, were found in the left apical and right diaphragmatic lobes. Moderate amount of foamy froth was found on the cut surfaces of the lung. The right heart ventricle was markedly dilated. Grayish, dry, necrotic cortex of pulmonary hilar lymph nodes were observed. Many eosinophilic, cytoplasmic inclusion bodies and toxoplasma organisms were found in the stamp smears from the lung tissue, demonstrable with Pollak and Wright stains.

Lung. Moderate alveolar hyperemia and edema with moderate septal cell infiltration were found in the alveoli, some of which contained eosinophilic, cytoplasmic inclusion bodies. Slight mononuclear infiltration in the perivascular and peribronchiolar connective tissue. Bronchiolar alteration and exudates were meager. Many foci of coagulation necrosis scattered in the lung tissue; celluar exudates in alveoli were amorphous pinkish and homogeneous. A considerable amount of fibrin was present in necrotic foci which showed no apparent zone of reaction cells. Many proliferating form of toxoplasma organisms were observed in alveolar lining cells.

Liver. Many sharply delimitted, microscopic-sized areas of coagulation necrosis were found, and some of which appeared to extend from portal area into acini. The necrotic areas, containing eosinophilic amorphous masses, in which some fibrin was present, were surrounded by apparently normal hepatic cells. *Toxoplasma* in proliferating form was found in hepatic cells and Kupffer cells. Moderate edema was present in Disse's space.

Pulmonary hilar lymph nodes. Extensive coagulation necrosis was found in the cortex along with a considerable amount of fibrin. Decreased lymphocyte count and atrophic lymph follicles were found in the medulla.

Central nervous system. Occasional glial nodules, mostly composed of microglias and small numbers of astrocytes and oligodendroglias, were found in the parenchyma of interbrain, midbrain and cerebellum. Neither toxoplasma organisms nor demyelinating encephalitis were demonstrable.

Isolation and identifiacation of toxoplasma

All mice exhibited roughened hair coat and sluggish movement 8-10 days after inoculation. Organisms giving morphological characteristics identical to *Toxoplasma gondii* were found in ascites of all inoculated mice (*Fig. 20*). All isolates were passaged and maintained in mice, and identificated serologically as *Toxoplasma gondii* (6).

DISCUSSION

The pathological and microbiological evidences presented indicate that the cases described here are canine toxoplasmosis complicated with distemper which terminated in fatal acute toxoplasmosis. The intestinal ulcers in cases 61-106 and 62-389 are considered as the primary site of *Toxoplasma* infection. The ulcer in case 62-389 indicates that the necrotic process in the muscular coat itself was not blood-borne; it is believed to be the result of direct extension of the primary leision. It also suggests that the

route of infection was *via* oral in these 2 cases, but is uncertain in case 62-305 due to the state of advanced decomposition.

Proliferating or encysted toxoplasma organisms are revealed in the brain tissues of cases 62-389 and 61-106. None of our cases exhibited lesions suggestive of reactivated latent toxoplasmosis in the central nervous system, as suggested by Koestner *et al.* (8). Case 62-389 exhibited fresh necrotic process in the brain tissue with the presence of extracellular proliferating *Toxoplasma* in nerve cells or glial cells of necrotic lesions, particulary numerous around the blood vessels (*Fig. 12*). This picture suggests hematogenic spread of organisms through brain-blood barrier in the central nervous system.

Case 61-106 is unique in that encysted form of *Toxoplasma* and glial nodules accompaning by demyelinating encephalitis are found, with intranuclear inclusion bodies in microglias and gemestocytes which are believed to be specific for canine distemper; while the other 2 cases are free of demyelinating encephalitis. According to Cordy (9), demyelinating encephalitis is apt to occur in canine distemper which course had been more than 10 days.

Experimental toxoplasmosis was hardly fatal in dogs, despite the injection of a large numbers of parasites (3). Moreover, distemper may activate latent toxoplasma infection in dogs and minks (10, 11). Campbell *et al.* stated that they have never observed a primary toxoplasma infection causing clinical signs in dogs (10). From the patho-anatomical point of view, case 62-389 was affected with canine distemper complicated with initial parasitemia of toxoplasmosis in this particular case: the flare-up latent toxoplasmosis was conceivably caused by concomitant distemper infection. The other 2 cases are considered to have experienced primary parasitemias earlier in their lives, judged by the nature of lesions in the central nervous system. The picture of parasitemias observed by us was apparently secondary, but no serological data was available to support this view.

We believe that the necrobiotic foci in lymph follicles of spleen, accompanied by the presence of intranuclear inclusion bodies in reticular cells, was induced by distemper virus. This is based on the findings from our own file of over 100 cases of canine distemper without complication of toxoplasmosis. The necrosis of such cases is not a delimitted necrotic lesion of coagulation type.

REFERENCES

1. MILLER, L. T. and H. A. FELDMAN. 1953. Incidence of antibodies for *Toxoplasma* among various animal species. *J. Inf. Dis.* **92**: 118-120.
2. LAINSON, R. 1956. Toxoplasmosis in England. III. *Toxoplasma* infection in dogs: The incidence of complement-fixing antibodies among dogs in London. *Ann. Trop. Med. & Parasitology.* **50**: 172-186.
3. JACOBS, L. 1957. The interrelation of toxoplasmosis in swine, cattle, dogs and man. *Pub. Hlth. Rept.* **72**: 872-882.
4. COLE, C. R., J. A. PRIOR, F. L. DOCTON, D. M. CHAMBERLAIN and S. SASALAW. 1953. Toxoplasmosis. III. Study of families exposed to their *toxoplasma*-infected pet dogs. *Arch. Int. Med.* **82**: 308-313.
5. PRIOR, J. A., C. R. COLE, F. L. DOCTON, S. SASALAW and D. M. CHAMBERLAIN. 1953. Toxoplasmosis. IV. Report on 3 cases with particular reference to asymtomatic *Toxoplasma* parasitemia in a young woman. *Arch. Int. Med.* **92**: 314-320.
6. PAN, I. C., S. S. YOUNG, C. C. WANG, Y. C. YEH, I. J. PAN and H. C. CHEN. 1962. TOXOPLASMOSIS IN DOMESTIC ANIMALS: Abortion and stillbirth in asymtomatic carrier gilts. *Bull. Inst. Zool., Academia Sinica.* **1**: 89-100.
7. GRAX, P. 1954. *The microtomist's formulary and guides.* Blackiston Co., Inc.
8. KOESTNER, A. and C. R. COLE. 1960. Neuropathology of canine toxoplasmosis. *Amer. J. Vet. Res.* **21**: 831-844.
9. CORDY, D. R. 1942. Canine encephalomyelitis. *Cornell Vet.* **32**: 11-28.
10. CAMPBELL, R. S. F., W. B. MARTIN and E. D. GORDON. 1955. Toxoplasmosis as a complication of canine distemper. *Vet. Rec.* **67**: 708-713.
11. MONBERG-JØRGENSEN, H. C. 1956. Toxoplasmose: forbindelse med hvalpesyge hos minken. *Nord. Veterinärmed.* 8: 239-242.

Fig. 1. Eosinophilic cytoplasmic inclusion bodies in a giant cell and septal cells. Stamp smear of lung tissue. Case 62-399. Pollak trichrome stain, 1,000×.

Fig. 2. Sublobular necrosis caused by *Toxoplasma.* Obviously necrotic alveolar walls with pinkish, homogeneous, amorphous alveolar contents. Case 62-389. H. &. E. stain, 80×.

Fig. 3. An area of coagulation necrosis with sharply delimitted margin in liver lobule. Cellular reaction is scanty. Case 62-389. H. & E. stain, 100×.

Fig. 4. Eosinophilic cytoplasmic (A) and intranuclear (B) inclusion bodies in parietal and chief cells of gastric mucosa indicated by arrows. Case 62-389. H. & E. stain, 320×.

Fig. 5. Obviously necrotic muscular coat of large intestine with marked inflammatory cell infiltration. Note intact mucosa. Case 62-389. H & E. stain, 80×.

Fig. 6. Enlarged view of *Fig. 5.* A group of proliferating *Toxoplasma* found in a muscular fiber of large intestine. Note necrotic muscular fibers and infiltrated inflammatory cells. Case 62-389. H. & E. stain, 400×.

Fig. 7. Necrotic white pulp in spleen. Arrows show intranuclear inclusion bodies in reticular cells. Case 62-389. H. & E. stain, 400×.

Fig. 8. Intranuclear inclusion bodies in pancreatic acinar cells indicated by arrows. Case 62-389. H. & E. stain, 400×.

Fig. 9. Extensive, diffuse coagulation necrosis of a lymph node. Case 62-389. H. & E. stain, 100×.

Fig. 10. Obviously necrotic brain tissue in which many extracellular *Toxoplasma* and pyknotic and karyorrhectic glial cells are seen. Case 62-389. H. & E. stain, 320×

Fig. 11. A group of proliferating *Toxoplasma* in a dead nerve cell seen at the periphery of a necrotic area. Note glial infiltration at the top of the field. Case 62-389. H. & E. stain, 400×.

Fig. 12. Groups of proliferating *toxoplasma* in glial and nerve cells around a capillary, suggesting hematogenic spread of the organisms. Case 62-389. H. & E. stain, 400×.

Fig. 13. A considerable amount of fibrin deposited in alveoli of a necrotic area of lung. Many septal cells and lymphocytes seen in alveoli of lower field. Case 62-106. H. & E. stain, 100×.

Fig. 14. Enlarged view of *Fig. 13.* Arrow shows many proliferating *Toxoplasma* seen in cytoplasm of a hypertrophic epithelium of a an alveolar duct. Note adenomatous arrangement of epithelial cells. Case 62-106. H. & E. stain, 400×.

Fig. 15. Many proliferating *Toxoplasma* in a desquamated giant cell in a respiratory bronchiole (A), a cytoplasmic inclusion body (B) and an intranuclear inclusion body (C) are also observed. Case 62-106. H. & E. stain, 400×.

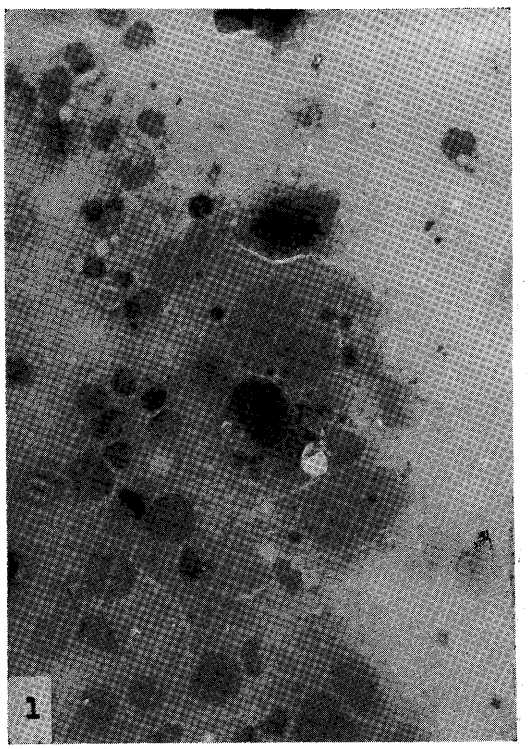
Fig. 16. A *Toxoplasma* cyst seen at the periphery of a microglial nodule in the brain. Case 62-106. H. & E. stain. 320×.

Fig. 17. A demyelinating area—*status spongiosus*—seen in the cerebellar subcortical white. Case 61-106. H. & E. stain, 100×.

Fig. 18. Enlarged view of *Fig. 17.* Moderate microglial and gemestocytic infiltration in the demyelinating area. Case 61-106. H. & E. stain, 400×.

Fig. 19. An intranuclear inclusion body seen in a gemestocyte. Case 61-106. H. & E. stain, 400×.

Fig. 20. A free, extracellular *Toxoplasma,* and many proliferating intracellular *Toxoplasma* within the cytoplasm of a macrophage. Smear preparation of ascite of an infected mouse. Wright stain, 1,000×.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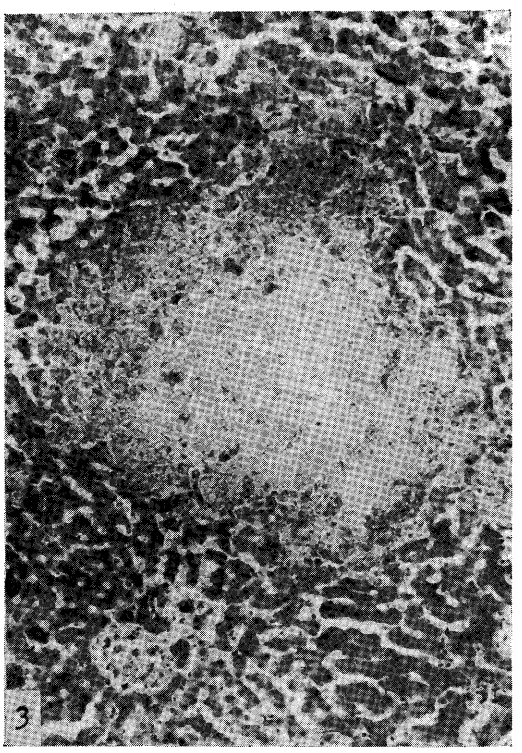
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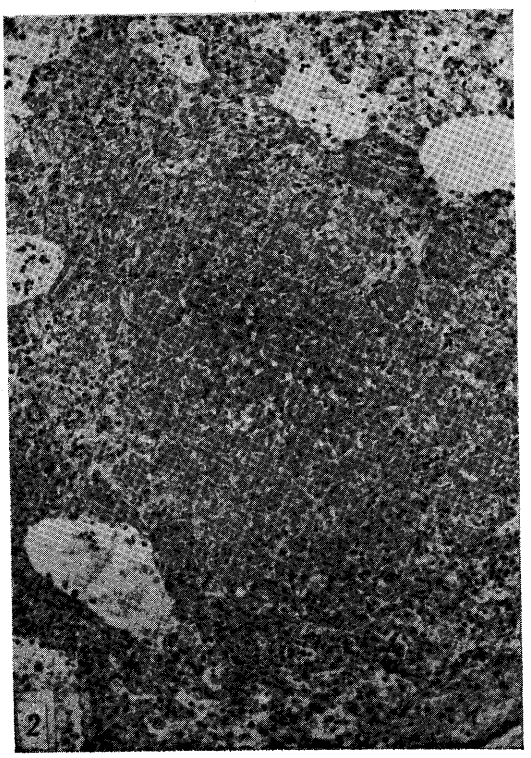
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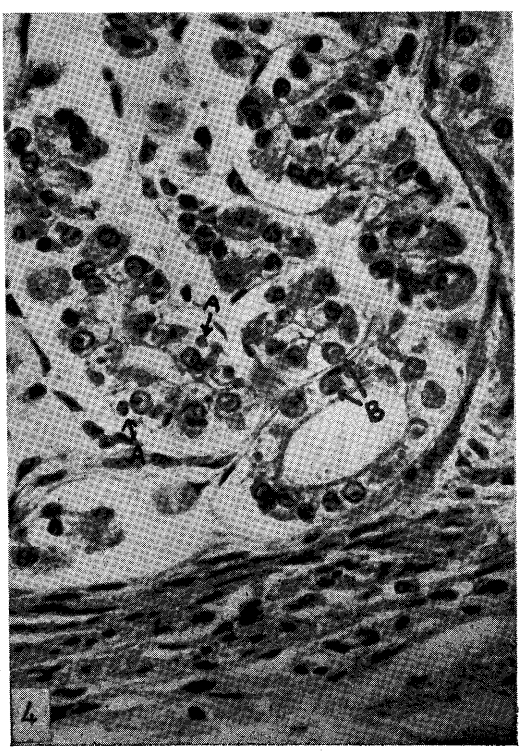
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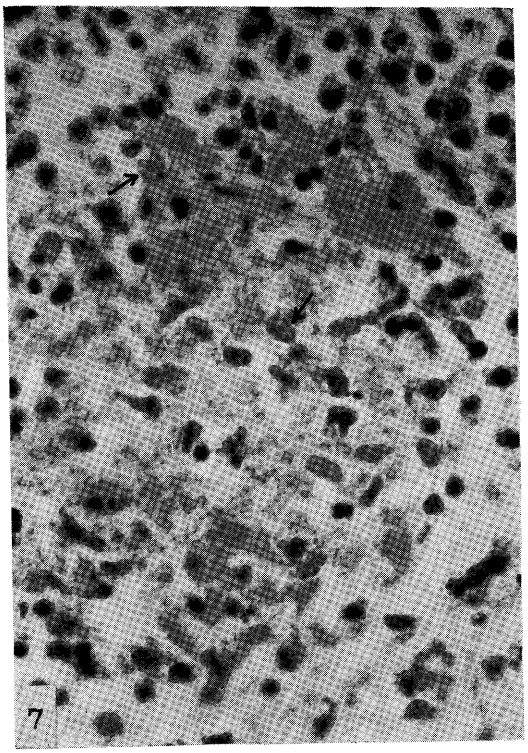
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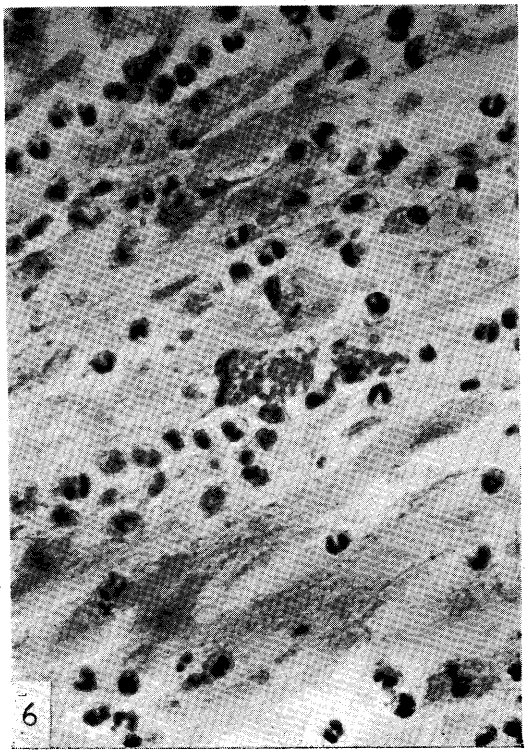
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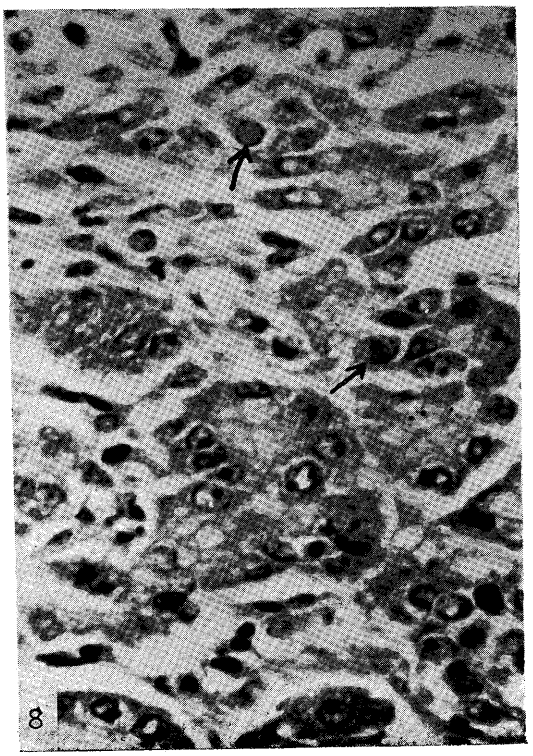
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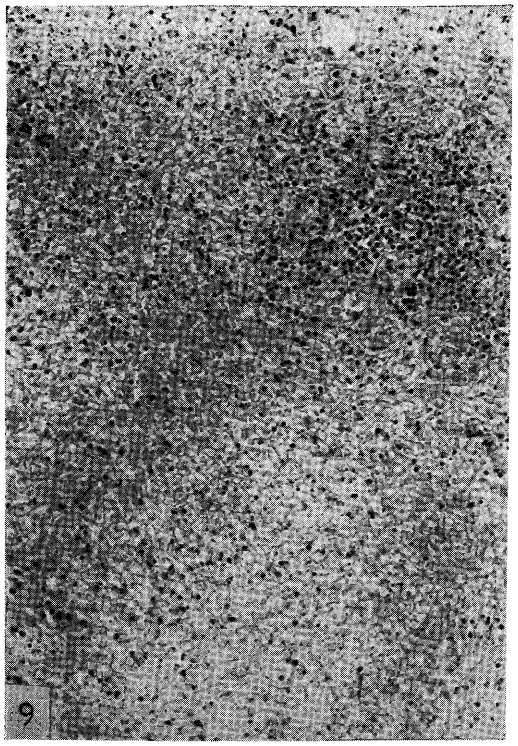
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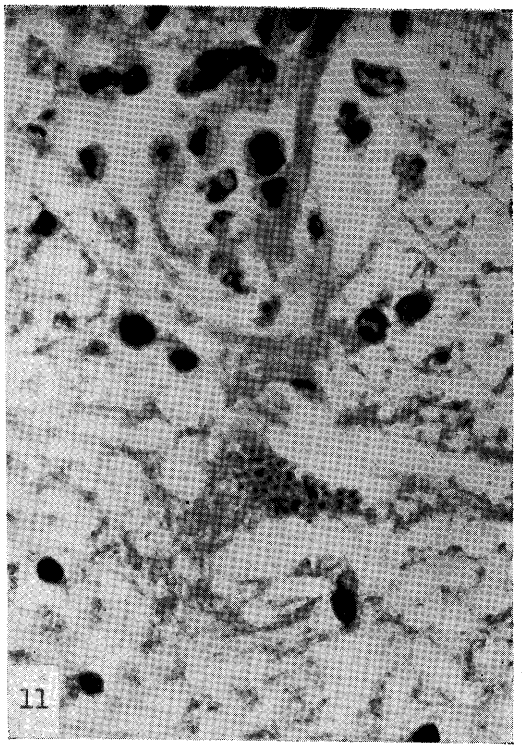
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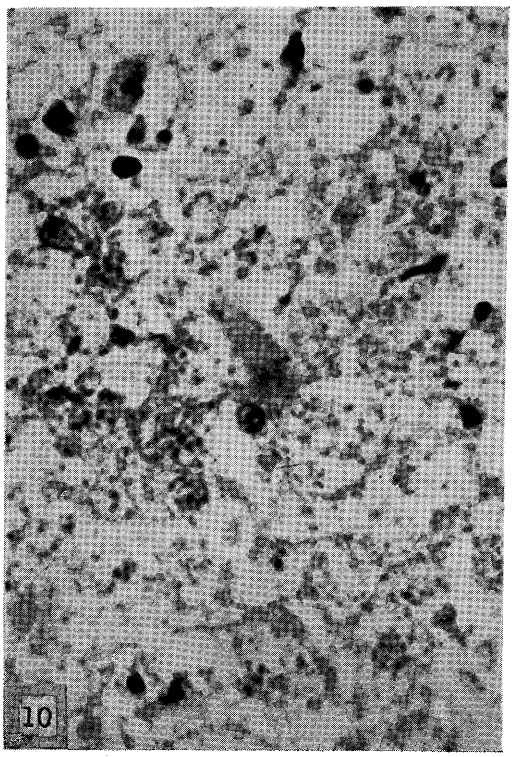
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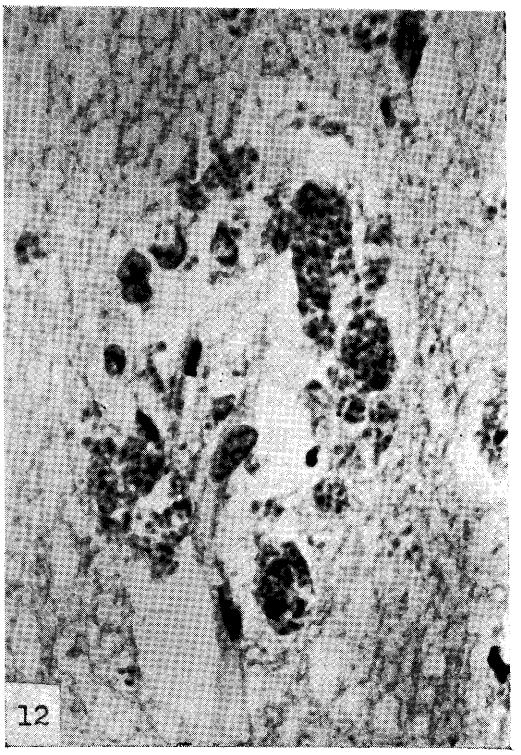
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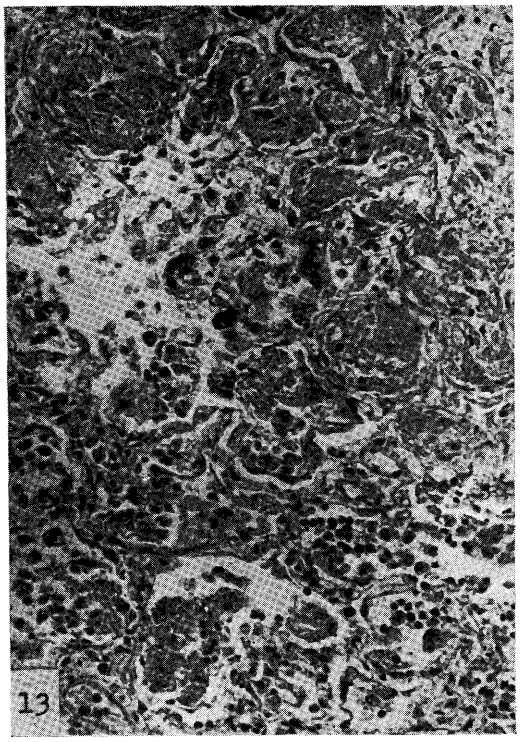
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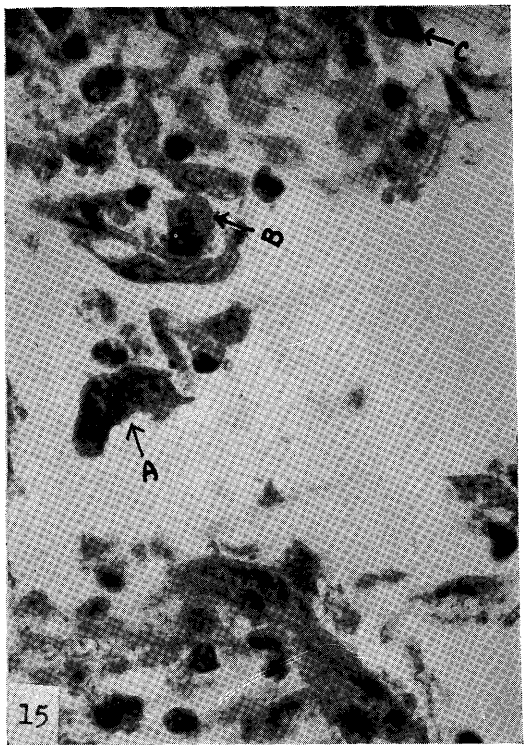
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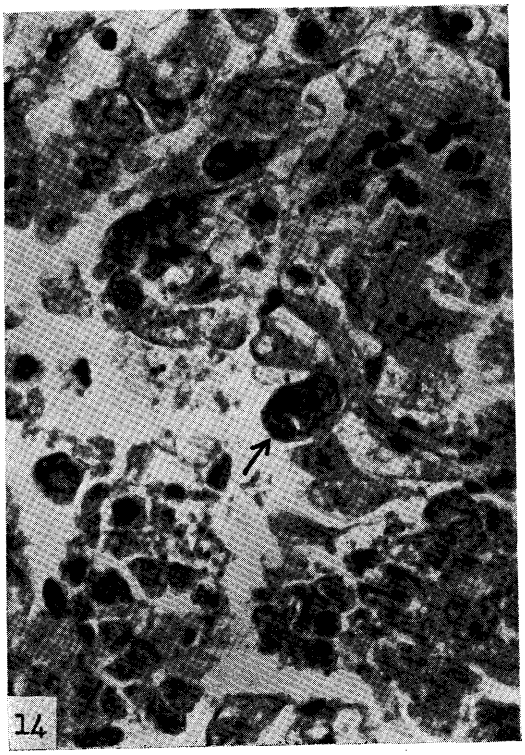
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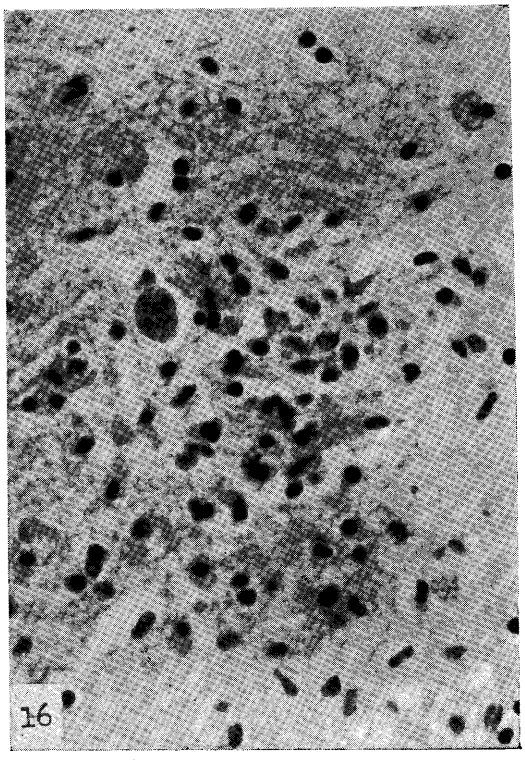
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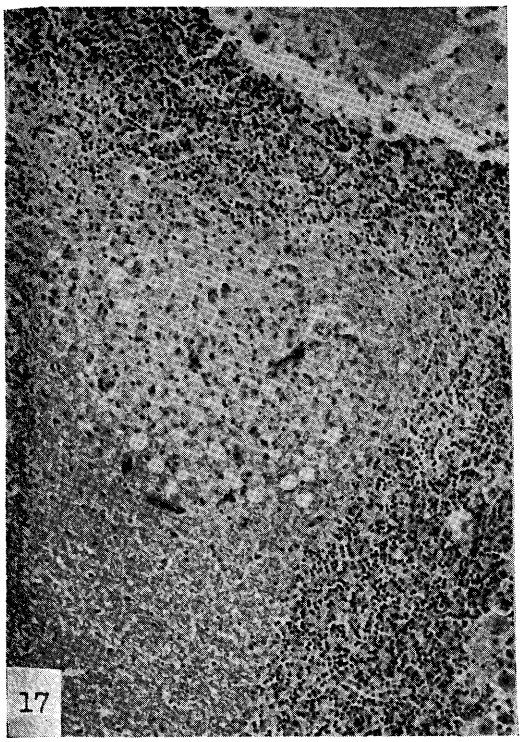
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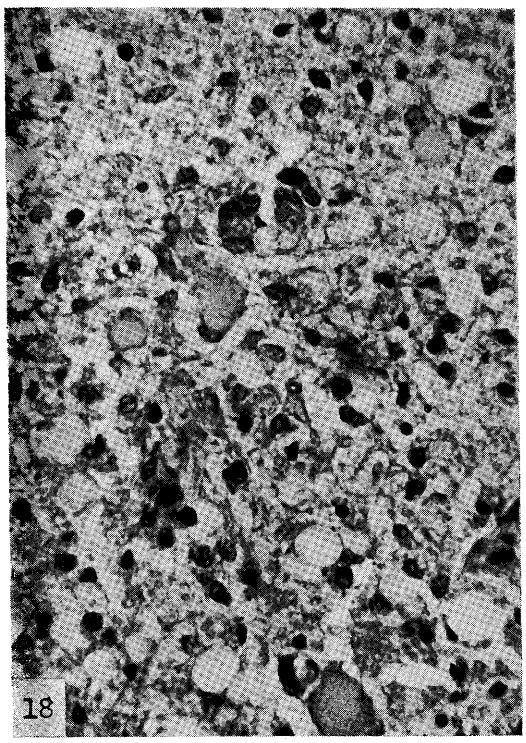
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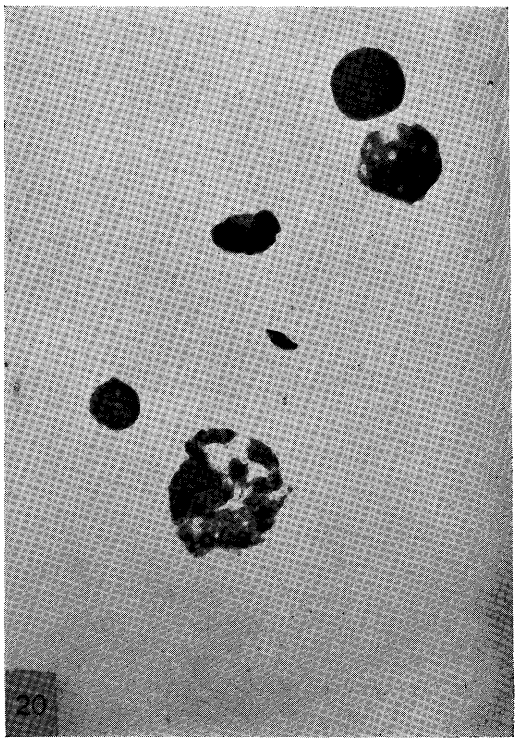
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