

Parasitism in Some Marine Mammals

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AMONG MARINE MAMMALS in captivity at the Naval Undersea Research and Development Center's Marine Bioscience Facility, Point Mugu, Calif., a variety of interesting pathologic features have been found, including bacterial infections and parasitic infestations. Parasitism has accounted for a major portion of the pathologic changes found in marine mammals.⁹ Parasitic infestation has been the subject of many reports.^{2,4,5} Endoparasites found have included a variety of cestodes, nematodes, acanthocephala,² and trematodes.⁶

Flukes identified as *Zalophotrema hepaticum* were reportedly found in the bile duct of an Atlantic bottlenose porpoise, *Tursiops truncatus*,¹ although it appears to be primarily a parasite of pinnipeds.⁶ The pathogenesis of infestation with *Braunina cordiformis*, another trematode that we have encountered on several occasions, was recently reported.¹⁰ A filariid nematode was reported from the right side of the heart and branches of the pulmonary artery of a harbor seal, *Phoca vitulina*.¹¹ What appear to be trematode ova were found in brain abscesses of a stranded common dolphin, *Delphinus bairdi*.⁷ Similar ova were found in the brains of 4 additional animals—2 *Lagenorhynchus obliquidens* and 2 *Tursiops truncatus*.³ The parasitic gastrointestinal nematode, *Anisakis marina*, was found to infect man as well as numerous species of sea mammals.¹²

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Miss Rosa Marie Wilson prepared histologic specimens for this study. Dr. M. B. Chitwood identified most of the parasites and Dr. Murray Dailey reviewed the manuscript and made helpful suggestions.

The following case histories illustrate the variety of parasitic conditions found among 4 species of porpoises, the northern elephant seal, and the California sea lion during the past 5 years. The incidence of parasitism is striking, and one cannot ignore the possible hazards of similar parasitism to men who work within the ocean environment.

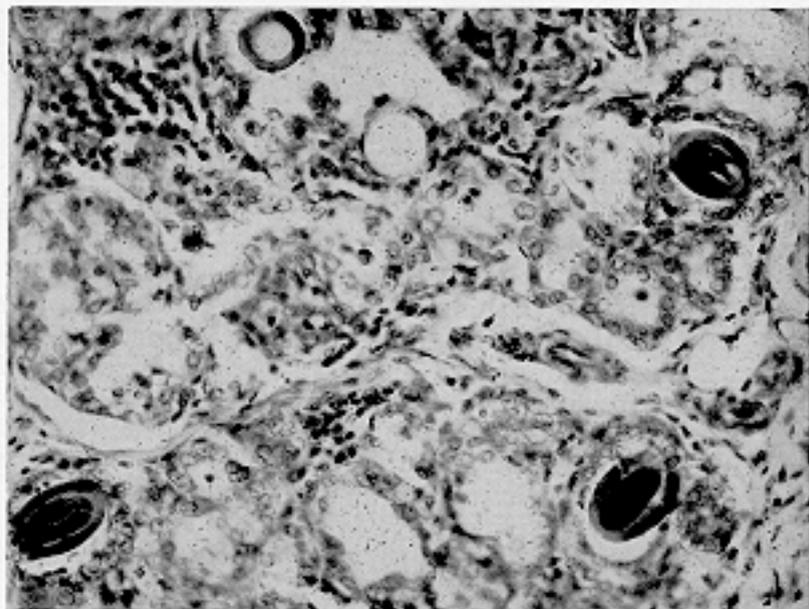
Case Histories

PHOCOENOIDES DALLI

Case 1.—An adult pregnant female Dall porpoise, *P. dalli*, weighing 115 kg. was captured east of Anacapa Island near Santa Barbara, Calif., on April 21, 1965. She adapted well to captivity and was taking food from the hand 4 days later. Food consumed during the entire period of captivity averaged 15 kg. each day. On the 24th day of captivity, her food consumption dropped to 7 kg. She ate very little thereafter and died on the 27th day of captivity.

Necropsy revealed the labia to be enlarged and the birth canal to be open. The cervix was dilated and fetal membranes were protruding from the cervix, but a fetus was not visible. Thick brown fluid exuded from the breasts when they were cut. The mammary glands were infested with *Placentonema sp.*, a uterine worm of whales. The dead fetus was near term, but it had not undergone autolysis; it was not deformed. Pleural membranes of the entire left thorax were markedly injected, and purulent exudate was found over the parietal pleural surfaces and anterior mediastinum. The fatty pad⁸ along the margin of the left lung was enlarged and extremely firm. The cut surface of the lung and

Fig. 1—Parasites (*Placentonema* sp.) in mammary tissue of *Phocoenoides dalli* (Dall porpoise). x 250.



fatty pad had a glistening, gelatinous, firm appearance. Bacteria cultured from fluid in the thorax and from the cut surface of the lung were identified as *Proteus vulgaris* and *Escherichia coli*.

Tissues collected at necropsy were fixed in formalin and processed for mounting in paraffin blocks. Tissue sections were cut at thicknesses of 4 to 6 μ and stained with hematoxylin-eosin or periodic acid-Schiff stain, or both.

The significant histologic findings were: The mammary tissue was the seat of lobular hyperplasia with marked secretory activity of acinar and ductal epithelium. Within the mammary tissue were scattered cross and tangential sections of yellow hyaline structures identified as *Placentonema* sp. (Fig. 1). Giant cells were not recognized, and there was no significant fibrosis nor infiltration of cellular elements around the worm.

The pleural surface of the left lung was covered by fibrin, polymorphonuclear leukocytes, and hyperplastic mesothelial cells. There was subpleural edema, with polymorphonuclear leukocytic infiltration of the subjacent pulmonary parenchyma, and focal abscessation. Within 1 abscess were fragments

of unidentified organized structures, suggestive of portions of a worm. Numerous additional sections failed to disclose sufficient detail for identification (Fig. 2).

Death was attributed to pneumonia and empyema probably caused by *P. vulgaris* and *E. coli* infection. There was also acute suppurative intrathoracic lymphadenitis. The parasites of the mammary glands, *Placentonema* sp., were not considered to have contributed to the death of the porpoise.

Case 2.—A 180-cm. long adult female Dall porpoise, weighing 80 kg., was taken in the Santa Barbara channel in January, 1965, and was apparently doing well, until she died suddenly after 1 month of captivity.

Examination at necropsy revealed several subcutaneous nodules, containing worms, on the posterior half of the body. Numerous worms were also found in the ducts of the mammary glands. Specimens from both these sites were identified as *Placentonema* sp. The subcutaneous nodules contained female parasites only. Parasites found in the mammary glands were of both sexes.

The trachea was filled with bloody froth, and there was considerable blood in the lungs. There were no other signs

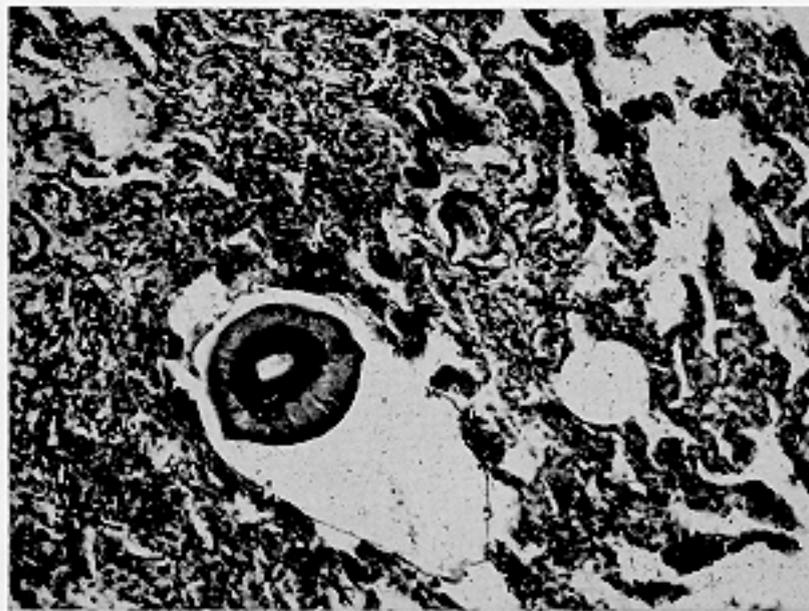


Fig. 2.—Cross section of unidentified worm in lung of a Dall porpoise, x 125.

of infection, and parasites were not found in the lungs. The cause of the intrapulmonary hemorrhage remained unknown.

Case 3.—A 188-cm. long, 113-kg. female Dall porpoise was captured for study of normal tissues on Aug. 14, 1965, fifteen miles west of Morro Bay, Calif. The animal was harpooned in the right thorax with a swordfish dart. The dart pierced the lung, but the animal continued to breathe and to fight the line attached to the dart. Air was bubbling from the wound, and there was a great deal of hemorrhage. Breathing continued for $\frac{1}{2}$ hour after capture and did not cease until after the intravenous administration of 2 Gm. of sodium pentobarbital. The animal was examined at necropsy immediately after death. Numerous small nematodes, *Stenurus minor*, were found in the sinuses of the head. There were no other gross abnormalities.

Histologic examination revealed no abnormalities, except in the lungs where, in the subpleural parenchyma, there were cross sections of worms surrounded by dense areas of fibrosis, infiltration of polymorphonuclear leukocytes, lymphocytes, macrophages, and some plasma-type cells. There were a few foreign body-type giant cells within this tissue.

These worms were also identified as *S. minor* (Fig. 3).

Case 4.—A 77-kg., 182-cm. long female Dall porpoise was captured on March 25, 1966, off the Southern California coast. She voluntarily ate squid and Spanish mackerel the day after capture and was eating well and seemed to be adapting for 8 days. On the 9th day, however, she had trouble swimming, struck her head against the walls, and stuck her head out of the water repeatedly. She frequently passed dark green, sometimes almost black, feces and regurgitated red-tinged fluid frequently. Attempts to resuscitate her after removal from the tank were accompanied by a great deal of regurgitation of fluid from the mouth.

Examination at necropsy disclosed small, firm, hard nodules averaging 0.5 cm. in diameter throughout both lungs which, in cross section, were found to contain a yellow pasty substance. Other areas of the lungs appeared hemorrhagic.

Histologic examination of the lung lesions revealed foci of complete necrosis surrounded by an intense accumulation of polymorphonuclear leukocytes and by moderately dense fibrous connective tissue infiltrated with similar cells, in addi-

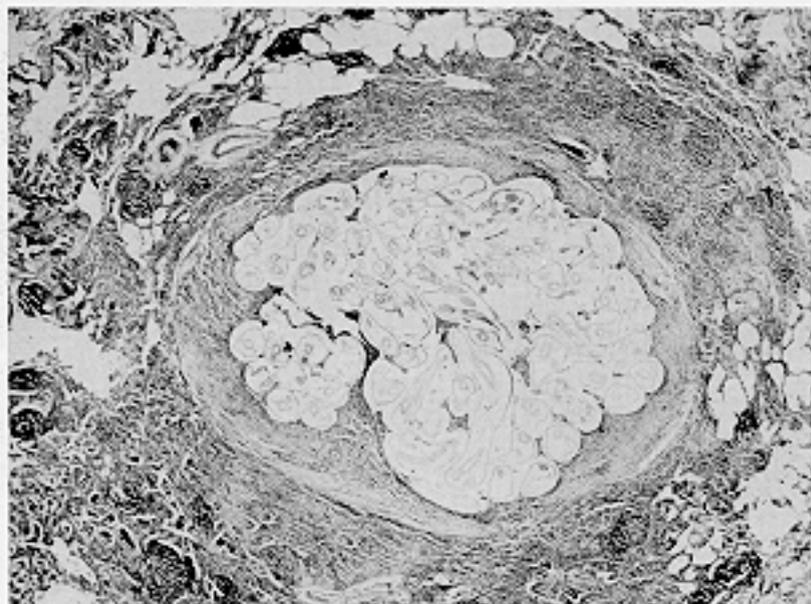


Fig. 3—Parasite (*Stenurus minor*) in lung of *Phocoenoides dalli* (Dall porpoise). x 25.

tion to lymphocytes and a few plasma cells. Eosinophils were infrequently observed. Within the necrotic areas were fragments of an unidentified substance, some of which was hyalinized and acidophilic. Some of these fragments resembled portions of worms, although degeneration was so extensive that identification was not possible. A few multinucleated foreign body-type giant cells laid within the wall near the locations of the unidentified substance. Alveoli in other sections of lung tissue, uninvolved by the inflammatory process, in some instances were markedly distended and partially filled with proteinaceous fluid and unidentified debris. Adjacent areas were markedly atelectatic. There was extreme hyperemia of the pulmonary parenchyma. Some bacterial colonization was found within alveoli. Death was attributed to pneumonia.

Case 5.—A 99-kg., 182-cm. long female Dall porpoise was captured approximately 8 miles south of San Nicholas Island on April 1, 1966. From the time of capture, she had trouble swimming, and she often ran into walls or swam in contact with walls. She never took food voluntarily during the 8 days she was in captivity. She was force-fed through

an equine stomach tube twice daily. On April 7, 1966, she passed a dead calf approximately 2 months premature, and the following day she was found dead.

Examination at necropsy revealed the uterus to be filled with blood. There was no evidence of infection. There were *Placentonema* sp. in the mammary tissue.

Histologic examination of lung tissue disclosed a rather marked, diffuse, acute bronchopneumonia involving both lungs. Examination of pancreatic tissue revealed fibrosis and calcified objects suggestive of foci of parasitic invasion.

TURSIOPS TRUNCATUS

A young female bottlenose porpoise, *T. truncatus*, 180 cm. long and weighing 78 kg., died suddenly, apparently as a result of choking on a fish.

Examination at necropsy revealed a forestomach filled with fish and parts of fish in the pharynx. Attached to the mucosa of the second stomach were trematode parasites, *Braunina cordiformis* (Wolf) (Fig. 4 and 5).

There were many nodules within the main and connecting stomachs which were tough and gritty and 0.5 to 1.5 cm. in diameter. These were found prin-

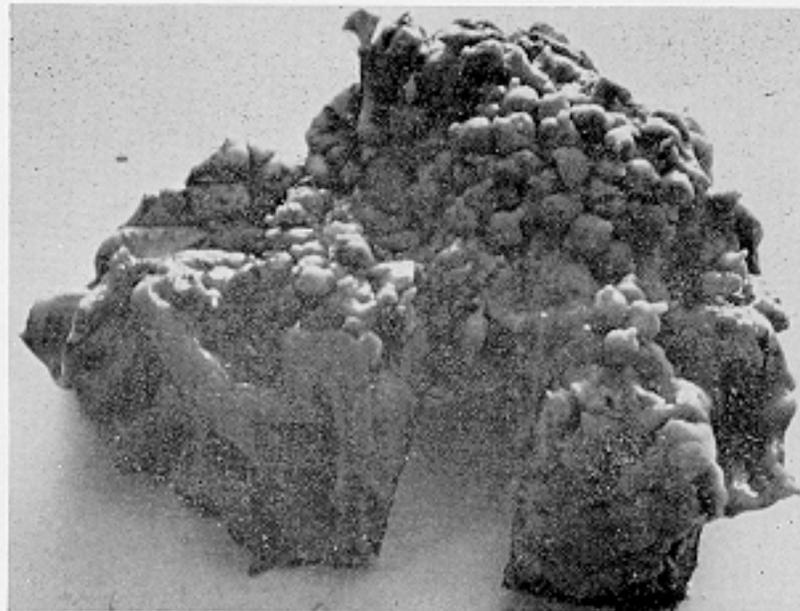


Fig. 4—Area of stomach mucosa of a *Tursiops truncatus*, with attached trematodes, *Braunina cordiformis*.

cipally near the pylorus and were identical to those found in another young female bottlenose porpoise that died of bronchopneumonia and pulmonary abscessation. Microscopic examination of the nodules disclosed within the muscular tissue extensive fibrosis and polymorphonuclear leukocyte infiltration surrounding cross sections of complicated worms (Fig. 6 and 7).

LAGENORHYNCHUS OBLIQUIDENS

Case 1.—A mature female white striped porpoise, *L. obliquidens*, was captured with a hoop net in the Santa Barbara Channel off Port Hueneme, Calif. Immediately after the porpoise was placed on the deck of the boat she started beating her tail in rapid swimming motions. This rapidly deteriorated



Fig. 5—Trematode, *Braunina cordiformis*, attached to stomach of *Tursiops truncatus* (Atlantic bottlenose porpoise). x 10.

Fig. 6—Cross section of fibrotic nodule surrounding trematode in muscularis mucosae of the stomach of a bottlenose porpoise.



into convulsive opisthotonos with nystagmus of both eyes. The porpoise died within 5 minutes after capture.

There was no specific change found on examination at necropsy that could be considered to have been responsible for the porpoise's death. Within the peritoneum and around the urinary bladder and uterine horns, large nodular areas were found. Histologic examination revealed these nodules to consist of granulation tissue surrounding cross sections of worms, *Phyllobothrium delphini*.

Case 2.—A female white striped porpoise weighing 64 kg. was captured in May, 1965. Two months later, she developed large blisters on both sides of the back just caudal to the dorsal fin. The tissue was necrotic, and *Pseudomonas aeruginosa* was isolated from it. The animal responded well to treatment with colistimethate sodium,* although an ulcerated area remained. In October,

* Coly-Mycin, Warner-Chilcott Laboratories, Morris Plains, N.J.

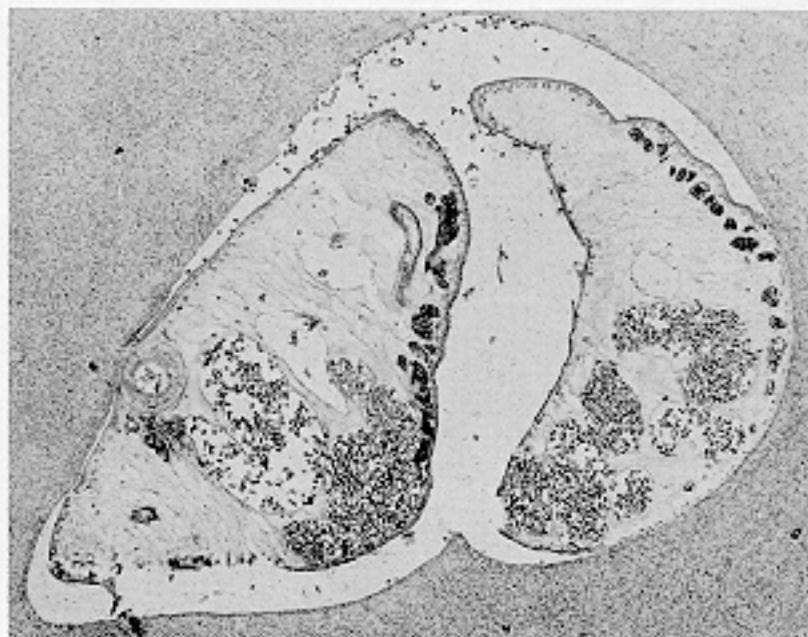


Fig. 7—Enlargement of Figure 6, x 35.

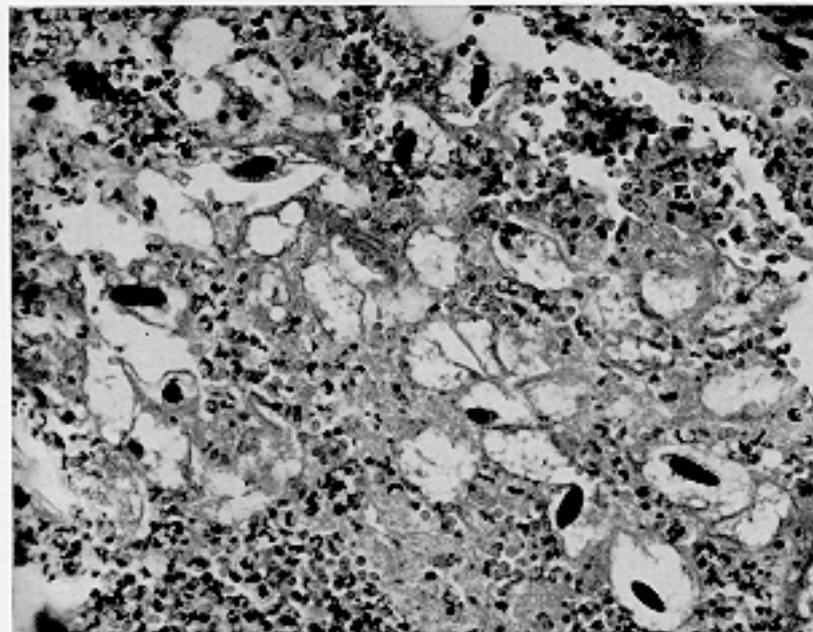


Fig. 8—Unidentified parasites in subcutis near skin ulcer in a Pacific white-striped porpoise. x 300.

1965, she was killed in an experiment involving anesthesia and a surgical procedure.

Examination at necropsy revealed no gross pathologic findings. Histologic examination of the skin obtained prior to death revealed ulceration, with an inflammatory reaction extending rather deeply into the underlying subcutaneous tissue. Within the inflammatory tissue involving the ulcer defect, numerous

small oval bodies with well-delineated cell outlines were found. Many of the oval bodies contained dark blue granular structures resembling portions of parasites; some were shaped like sausages. The greatest diameter of the structures was approximately $30\ \mu$. The contents were otherwise composed of a finely granular acidophilic substance. These bodies were not identified (Fig. 8).

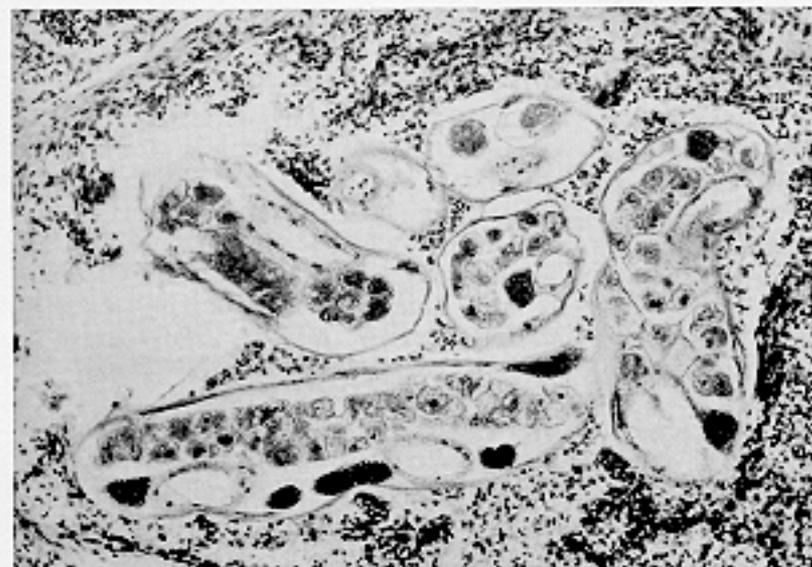
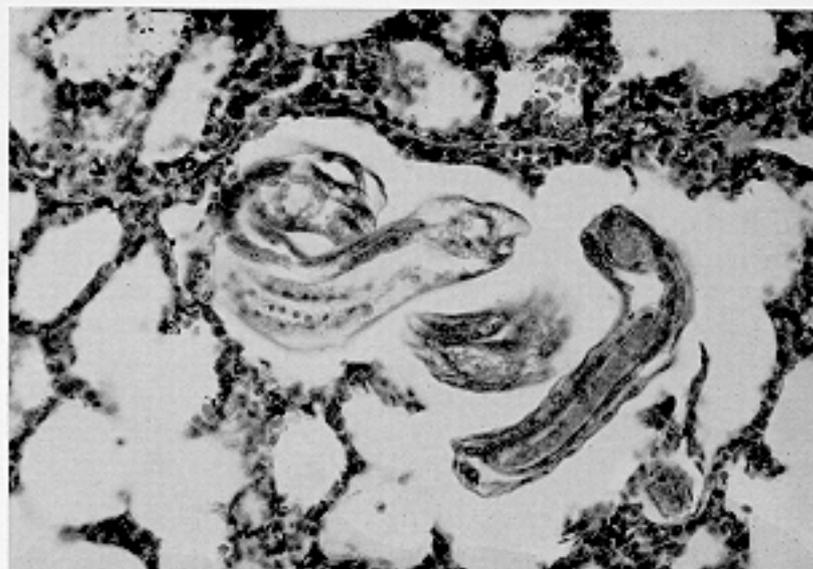


Fig. 9—Parasite tentatively identified as *Parafilaroides decorus* in lung of California sea lion. x 125.

Fig. 10—Unidentified parasite in lung of *Mirounga angustirostris* (Elephant seal). $\times 75$.



ZALOPHUS CALIFORNIANUS

A female California sea lion, *Z. californianus*, weighing 22.5 kg. was found on the beach near Point Mugu on Sept. 3, 1965. The animal was obviously sick and appeared to have a respiratory infection. She was given an injection of 96-hour-acting penicillin, and on the 5th day, she ate a small amount of squid. The animal died on the 6th day of captivity.

Examination at necropsy revealed the right lung to be of increased weight; a palpable induration was found throughout the parenchyma. Numerous worms were found in the fundus of the stomach as well as in the pylorus.

Microscopic examination of an infected site within the stomach revealed it to be the seat of marked degeneration. Acidophilic structures with hyaline-type walls were found associated with small, doubly refractile, walled structures. The latter contained blue granular inclusions resembling ova. They were surrounded by polymorphonuclear leukocytes, histiocytes, and some plasma cells, and were associated with a dense fibrous connective tissue response.

Some of these structures appeared to be free within the ulcer base. The caudal part of the intestine had some ulcerated areas, and 1 of the intrathoracic lymph nodes appeared calcified.

Microscopic examination of tissue sections of the right lung revealed diffuse infiltration of polymorphonuclear leukocytes and large macrophages into interstitial connective tissue and alveolar spaces. Bronchi were filled with similar inflammatory cells. There were parasites in much of the pulmonary parenchyma surrounded by an intense area of inflammation, beyond which were zones of fibrosis.

The parasites found in the stomach were identified as *Contraecaecum osculatum*, and those in the lungs were tentatively identified as *Parafilaroides decorus* (Fig. 1).

MIROUNGA ANGUSTIROSTRIS

A male northern elephant seal, *M. angustirostris*, 136 cm. long and weighing 22.6 kg., was found on the beach at Point Mugu on April 12, 1966, extremely emaciated. The seal had a purulent nasal discharge. This, together with the findings of labored breathing and a rectal temperature of 103 F. (39.5 C.), suggested pneumonia. He was placed on formula feeding via stomach tube very 4 or 5 hours, and antibiotics (penicillin-streptomycin and chloramphenicol) were given twice daily. The seal died 9 days after he was found. Examination at necropsy revealed some worms in the

stomach and hemorrhage in the caudal part of the small intestine.

Microscopic examination of the lungs revealed no evidence of acute pneumonia. There was marked passive hyperemia, and the lumens of small arteries and veins were filled with organizing thrombi. Small nematode parasites were found in many alveoli (Fig. 10). These were not identified.

Death was attributed to respiratory failure caused by thrombosis of pulmonary arteries and veins, the nature of which was not understood, but was probably related to the nematodes found in the lungs.

TURSIOPS GILLI

A very old male Pacific bottlenose porpoise, *T. gilli*, weighing 200 kg., was captured in November, 1965, near Catalina Island. The animal died in the spring of 1966 and was perfused *in situ* with 10% formalin solution. On examination at necropsy, many calcified masses were found within the lungs. On histologic examination, the lungs were found to have calcified foci throughout. These were surrounded by a thin zone of fibrosis, with little infiltration of inflammatory cells. There were particles of what appeared to be degenerated parasites within these foci. These were not identified.

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