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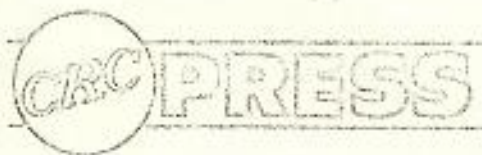
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XII. REPTILES*

Leonard H. Billups and John C. Harshbarger

Assessment of the incidence of (neoplasia) in reptiles is difficult due to the relatively small number of reported cases, almost all of which were discovered in animals held captive in zoos and herpetariums. The near absence of reptile neoplasms discovered in the field is probably due in large part to the mutual avoidance between reptiles and people plus an increased susceptibility of affected animals to predators and infections. Recently the number of cases being reported has been increasing, partially as a result of the current emphasis on finding new experimental animal models for the study of human diseases.

The etiology of spontaneous neoplasms in reptiles is not yet known, but sarcomas have been experimentally induced in the snake, *Eryx tataricus*, the turtle, *Testudo horsfieldi*, and two lizards with the Schmidt-Ruppin strain of Rous sarcoma virus.^{1,2} Based on the similarity of the Rous virus to avian leucosis virus and the close phylogenetic proximity of reptiles to birds and mammals, Dawe suggested in his review³ that the effects of avian and murine leucosis viruses should be studied in reptiles. Subsequently, Zeigel and Clark^{4,5} discovered C-type virus particles in splenic cells derived from a Russell's viper with a myxofibroma in the connective tissue anterior to the heart, but the C-type virus particle did not show common antigens with either murine or avian leucosis viruses. Oncogenic properties have not been determined for this RNA virus.

An investigator should be cautioned that cutaneous granulomas in reptiles often mimic neoplasia.⁶ For example, *Mycobacterium* sp. can produce focal uniform histiocytic lesions which have been mistakenly diagnosed as neoplasia. These lesions can be easily differentiated from neoplasia by use of the Ziehl-Neelsen acid-fast stain to demonstrate the mycobacteria.

Limited available data suggest wide variations in age of onset of neoplasia among species and families of reptiles (Table 7). This could be influenced by a number of factors such as difference in life span among species and whether

free-living or captive, but generally it appears that neoplasia in captive reptiles occurs more frequently in the older animals, as it does in mammals.

Excellent descriptions of the gross and microscopic features of numerous reptile neoplasms are presented in the literature surveys by Schlumberger and Lucké,⁷ Schlumberger,^{8,9} and Wadsworth.^{10,11} Other helpful surveys are provided by Page¹² and Reichenbach-Klinke and Elkan.¹³ Tables 4 to 7 list both published and unpublished cases of reptile neoplasms on file in the Registry of Veterinary Pathology at the Armed Forces Institute of Pathology and in the Registry of Tumors in Lower Animals at the Smithsonian Institution.¹⁴ However, most of the discussion section in this paper concentrates on the published cases. Some overlap was unavoidable among the seven tables in an effort for completeness.

A. Neoplasms in Snakes (Serpentes)

1. Neoplasms of Epithelial Origin

According to cases cited in the literature, the majority of neoplasms in snakes are of epithelial origin and most of these occur in the digestive system. Beginning with the oral cavity, Wadsworth⁶ reported a squamous cell carcinoma attached to the lateral border of the lower left mandible, and Kast¹⁵ described the only known tooth tumor in reptiles, an ameloblastoma invading the roof of the mouth of a 20-year-old male *Python molurus*. Ball¹⁶ reported bilateral malignant melanomas in the upper labial folds and a rhabdomyoma of the palate in the male of a mated pair of pine snakes *Pituophis melanoleucus*. Interestingly, the female developed a subcutaneous malignant melanoma of the trunk.

Proceeding caudally along the digestive tract, no primary neoplasms have been discovered in the esophageal mucosa. In the stomach, Vaillant and Pettit¹⁷ reported a cystic adenoma, but, based on their description, the diagnosis has been questioned.⁷ Two neoplasms of the intestines have been reported by Wadsworth:^{10,11} an adeno-

*The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

carcinoma in a canebrake rattlesnake and an adenoma in a timber rattlesnake. Finally, Smith and Betz¹⁸ described a carcinoma in the cloaca of an adult corn snake which caused an intestinal obstruction.

Subsequent to the discovery of an adenocarcinoma in a Say's pine snake,¹⁹ Ratcliffe examined a series of 136 snakes of five different families that died in a zoological garden.²⁰ Forty-five showed a sequence of pancreatic lesions varying from small foci containing distorted and dilated acini to adenomatoid structures embedded in a large fibrous stroma which had replaced all the normal parenchyma. In addition, 10 of 261 sacrificed snakes showed early stages of the diseases. Metastases were never found, but local invasion occurred in the more advanced cases, and Ratcliffe interpreted these findings as a progression of stages culminating in carcinomas.

Cowan²¹ lists, without further comment, a benign hepatoma in the liver of a massurana and a bile duct adenoma in a black-necked cobra. From the records of the Philadelphia Zoological Garden, Bergman²² reported that a papillary carcinoma of the bile duct of an East Indian water snake was the only tumor found in 2,200 wild snakes examined. An adenocarcinoma has been reported from the kidney of a ring snake by Patay.²³

Melanomas have been described several times in addition to the cases in the two pine snakes already mentioned. Schlumberger and Lucké⁷ reported melanomas in two female *Python reticulatus* specimens (Figure 1). The first python had a rapidly growing, ulcerated, bleeding tumor on the mid-left lateral surface of the trunk which had invaded the vertebral bodies and the coelomic cavity and had metastasized to the kidney. The second python had multiple subcutaneous non-malignant melanomas located at different sites. Heterografts to the anterior chamber of the eye were unsuccessful. Recently, Elkan²⁴ presented an excellent gross and microscopic description of a malignant melanoma in a male Florida pine snake, *Elaphe obsoleta*.

2. Neoplasms of Mesenchymal Origin

Snake neoplasms of mesenchymal origin appear to be less common than those arising in epithelium. Included in the known cases are fibromas and fibrosarcomas in the connective tissue of several species.^{11,25-27} Two possible muscle neoplasms have been reported in pine snakes: an

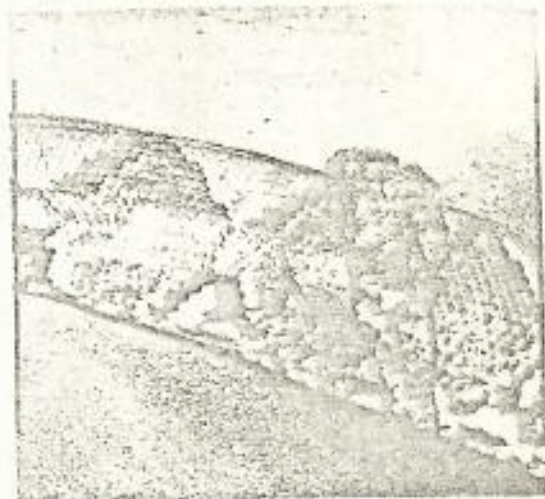


FIGURE 1. Malignant melanoma in the skin of a reticulated python. (National Zoological Park, Washington, D.C., Dr. Hans Schlumberger, prosector. AFTP Photo No. N-81881.)

abdominal leiomyosarcoma²¹ and a rhabdomyoma.¹⁶ The rhabdomyoma arose in the hard palate, and the possibility of it being a teratoma in which striated muscle had replaced the other tissues was also considered.

As shown in Table 1, neoplasms involving hematopoietic tissues in snakes have been reported several times, beginning in 1968.^{21,28-30} In the most recent example, Frye and Carney³¹ described an acute lymphatic leukemia in an immature male *Boa constrictor*. Blood smears taken prior to euthanasia contained large numbers of lymphocytes, many of which were in mitosis. Microscopic examination of tissue sections did not show invasion of leukemic cells. The bone marrow contained the normal differentiation of erythroid and granulocytic elements. Lymphoid cells in the spleen graduated from mature lymphocytes to primitive reticulum cells.

B. Neoplasms in Turtles (Chelonia)

1. Neoplasms of Epithelial Origin

Throughout the vast distribution of the green sea turtle, *Chelonia mydas*, fibroepithelial papillomas have been observed principally on eyelids, neck, flippers, and tail (Figure 2). The tumors range from tiny epithelial warts to huge masses, 20 cm or more in diameter, of subcutaneous connective tissue covered with several layers of keratinizing squamous epithelium⁷ (Figure 3). Ova of the parasitic trematode, *Haplotrema con-*



FIGURE 2. Multiple cutaneous papillomas on head and soft parts of a green sea turtle (*Chelonia mydas*). (Contributor: G. H. Waddell, RTLA No. 12.)

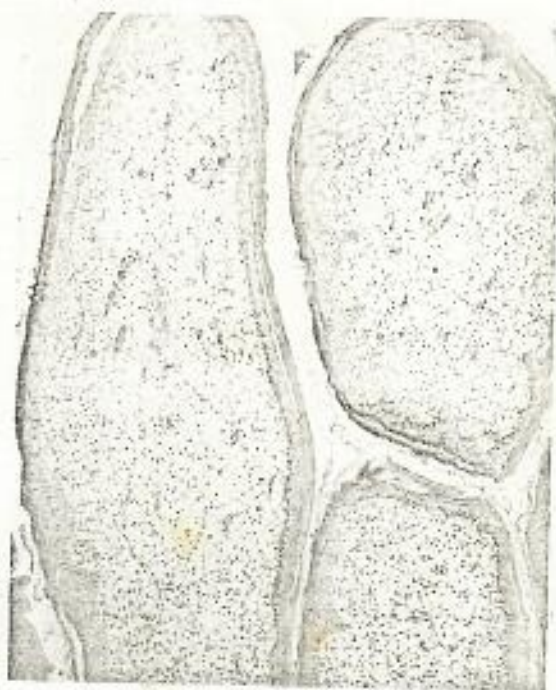


FIGURE 3. Microscopic section through a papilloma. Note epithelium-covered loose connective tissue cores. Green sea turtle (*Chelonia mydas*). (Slide contributed by G. H. Waddell, AFIP Neg. No. 74-7641.)

strictum (subsequently synonymized with *Distomum constrictum*³²), were found in more than one half of the 250 tumors examined by Smith and Coates,³³ but they were not considered to be of etiological significance. Nigrelli and Smith,³⁴ however, found numerous leeches, *Ozobranchius branchiatus*, associated with the fibroepithelial tumors they examined. There was an increased vascularity of the tumors proximal to the leeches, and it was suggested that hirudin secreted by leeches could have directly stimulated the tumor growth. Green sea turtles also develop a papillomatous hyperplasia of the mucus membrane of the gall bladder when parasitized by the fluke, *Ligytydoides similis*.³² Musk turtles, *Stemochelys odoratus*, develop wartlike papillomas.⁷

Two malignant epithelial neoplasms have been reported by Ippen³⁵ in different species of tortoises. In one case he describes a renal adenocarcinoma with liver metastases in a *Terrapene carolina*. The other case was described as a thyroid carcinoma in *Chrysemys picta*, but it has also been interpreted as a parathyroid adenoma (Table 6). A thyroid adenoma was reported by Pick and Poll³⁶ in a *Platemys geoffroyana*.

2. Neoplasms of Mesenchymal Origin

Reported cases of mesenchymal tumors pri-

marily involve lymphoreticular tissues (Table 6). A myeloproliferative disease, characterized by an intravascular proliferation of blast forms of the myeloid and erythroid cell series, has been described in a Mobile terrapin, *Pseudemys elegans*.³⁷ The lymphoid cells were normal as determined by blood films. Tissue sections revealed mitoses of proliferating cells in the spleen, lungs, and intraluminal portions of blood vessels. Death was due to pulmonary hemorrhage, probably secondary to thrombocytopenia. Descriptions of bone marrow and other lymphoreticular tissues were not reported.

C. Neoplasms in Lizards (Lacertilia)

1. Neoplasms of Epithelial Origin

In at least one lizard genus (*Lacerta*), neoplasms of epithelial origin appear to be relatively common.³⁸ Stolk described multiple hyperkeratotic nodules in the skin of seven *Lacerta agilis* specimens which gradated into lesions that resembled carcinoma planocellulare (squamous cell carcinoma) in man.³⁹ These lesions only developed in animals exposed to decreased amounts

of sunlight; those maintained in direct sunlight were without neoplasms.

Epidermal papillomas have been described in *L. agilis*,⁴⁰ *L. muralis* (cited elsewhere),⁷ and *L. viridis*.³⁸ Keratinizing squamous cell carcinomas have also been reported in *Tupinambis teguixin*⁴¹ and *T. nigropunctatus*.⁷

2. Neoplasms of Mesenchymal Origin

As in snakes and turtles, neoplasms of lymphoreticular tissue of lizards have rarely been reported until recent studies. The first report of hematopoietic neoplasia in lizards was by Zwart and Harshbarger (1972).⁴² One case was in a female East Indian water lizard (*Hydrosaurus amboinensis*) from the Amsterdam Zoo. Autopsy revealed hepatomegaly and splenomegaly, swollen kidneys, and multiple whitish foci in the lungs. Microscopic examination revealed infiltration of poorly differentiated lymphoid cells in the myocardium, spleen, kidneys, liver, and lungs. A

second case in a Malayan monitor lizard (*Varanus salvator*) had similar postmortem findings but was complicated by concomitant disseminated granulomas. However, the authors felt that this case was probably compatible with generalized lymphosarcomatosis. Other reported tumors of mesenchymal origin are listed in Table 2.

D. Neoplasms in Crocodiles (Crocodylia)

Except for the mention of a crocodile with warts by von Hansemann (cited elsewhere),⁷ the only reported neoplasm in this family of reptiles was described in a young porose crocodile (*Crocodylus porosus*) which showed symptoms of central nervous system involvement.⁴³ At necropsy, tumorous masses were discovered on the ventral surface of the cerebellum, the right auricle of the heart, and numerous foci were present in the liver. The tumor was diagnosed as a primary sarcoma of the liver with metastases to the heart and brain.

TABLE 1

Summary of Spontaneous Neoplasms Reported in Snakes (Serpentes)

| Authors | Species | No. of animals | Diagnosis | Site |
|---------------------------------------|---|----------------|-------------------------------|---|
| Bull ¹ | Five snakes, <i>Pituophis melanoleucus</i> | 1 | Melanoma, malignant | Tail, metastatic to skin, liver, and body cavity |
| | <i>P. melanoleucus</i> | 1 | Rhabdomyoma; | Hard palate |
| | | 1 | melanoma, malignant | Upper labium |
| Cowan ² | Massarana, <i>Pseudoboa clevelandii</i> | 1 | Benign hepatoma | Liver |
| | Black-necked cobra, <i>Naja nigricollis</i> | 1 | Bile duct adenoma | Liver |
| | Water moccasin, <i>Agkistrodon piscivorus</i> | 1 | Sarcoma | Stomach |
| | Bull snake, <i>Pituophis catenifer</i> | 1 | Adenocarcinoma | Colon |
| | <i>P. melanoleucus</i> | 1 | Sarcoma (? Leiomyosarcoma) | Abdominal cavity, metastatic to liver, pancreas, celiac area |
| | Egyptian cobra, <i>Naja naja</i> | 1 | Lymphosarcoma | Metastatic to heart, liver |
| | Hognose snake, <i>Heterodon platyrhinos</i> | 1 | Lymphosarcoma | Metastatic to lungs, liver, kidneys |
| | River Jack, <i>Bitis asticorhis</i> | 1 | Lymphosarcoma | Metastatic to liver, kidneys, adrenal glands, spleen, gut wall |
| Flint ³ | Indian python, <i>Python molurus</i> | 1 | Lymphoid leucosis | Disseminated |
| Frank and Schepky ³ | Assassin, <i>Eunectes murinus</i> | 1 | Lymphosarcoma | Liver, metastatic to thyroid, spleen, pancreas, kidneys |
| Griner (cited elsewhere) ⁴ | Timber rattlesnake, <i>Crotalus horridus horridus</i> | 1 | Lymphoid leukemia | Lungs, liver, intestine, heart, skin, kidneys, skeletal muscles |

TABLE 1 (continued)
 Summary of Spontaneous Neoplasms Reported in Snakes (Serpentes)

| Authors | Species | No. of animals | Diagnoses | Site |
|----------------------------------|---|----------------|--|---|
| Griner (continued) | | | | |
| - | Death adder, <i>Acanthopis antarticus</i> | 1 | Reticulum cell sarcoma | Intestine or body wall; probable primary site; subcutaneous tissue, skeletal muscles, liver, pancreas, spleen, lung |
| Kust ¹³ | Tiger python, <i>Python molurus</i> | 1 | Amblioblastoma | Upper jaw |
| Orr et al. ¹⁴ | Rattlesnake, <i>Crotalus horridus</i> | 1 | Fibroma | Tail, dorsum |
| Patay ¹⁵ | Ringsnake, <i>Tropidonotus natrix</i> | 1 | Adenocarcinoma | Kidney |
| Vallant and Pettit ¹⁷ | Python | 1 | Fibroma | Stomach |
| Ratcliffe ¹⁸ | <i>Crotalus adamanteus</i> | 18 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>C. confluentus</i> | 6 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>C. horridus</i> | 6 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>C. ruber</i> | 7 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>Storerus miliaris</i> | 1 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>Agkistrodon mokasen</i> | 1 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>Pituophis melanoleucus</i> | 1 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>P. sayi</i> | 1 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>Coluber constrictor</i> | 6 | Adenocarcinoma (early and late stages) | Pancreas |
| - | <i>Lampropeltis getulus</i> | 2 | Adenocarcinoma (early and late stages) | Pancreas |

Summary of Spontaneous Neoplasms Reported in Snakes (Serpentes)

| Authors | Species | No. of animals | Diagnoses | Site |
|---|---|----------------|---|---|
| Ratcliffe (continued) | | | | |
| - | From family Boidae | 3 | Adenocarcinoma (early and late stages) | Pancreas |
| - | From family Elapidae | 2 | Adenocarcinoma (early and late stages) | Pancreas |
| - | From family Viperidae | 1 | Adenocarcinoma (early and late stages) | Pancreas |
| Schlimbarger and Lacké ¹ | <i>Python reticulatus</i> | 1 | Melanoma, malignant | Trunk, metastatic to kidney Jaw; trunk |
| - | <i>P. reticulatus</i> | 1 | Melanoma, nonmalignant | Cloaca |
| Smith and Betz ^{1,6} | Corn snake, <i>Elaphe guttata</i> | 1 | Carcinoma | - |
| Snyder (cited elsewhere) ^{7,8} | Hopnose snake, <i>Heterodon platyrhinos</i> | 1 | Reticulum cell sarcoma | - |
| Wadsworth ^{1,6} | African black cobra | 1 | Osteochondrosarcoma | Spinal column |
| - | Western diamondback rattlesnake | 1 | Fibrosarcoma | Neck |
| - | Western hognose snake | 1 | Sarcoma (unidentifiable cell type) ^{1,6} | Cloaca |
| Wadsworth ^{1,7} | Southern Pacific rattlesnake, <i>Crotalus viridis</i> | 1 | Cystic hemangioma | Cloaca |
| - | Australian black snake | 1 | Fibrosarcoma | Subcutis |
| - | Black rat snake, <i>Elapina obsoleta</i> | 1 | Hemangioadenocarcinoma | Intestine |
| - | Canebrake rattlesnake, <i>Crotalus horridus</i> | 1 | Adenocarcinoma | Intestine |
| - | Timber rattlesnake | 1 | Adenoma | Intestine |
| - | Pilot black snake | 1 | Fibroma | - |
| - | Anaconda, <i>Eunectes murinus</i> | 1 | Adenomatous polyp | Stomach |
| Wadsworth ⁸ | Water moccasin | 1 | Squamous cell carcinoma | Mandible, lower left |
| Zelick and Clark ⁴ | <i>Vipera mesolepis</i> | 1 | Myxofibroma | Pericardial, metastatic to spleen |

TABLE 2

Summary of Spontaneous Neoplasms Reported in Lizards (Lacertilia)

| Authors | Species | No. of animals | Diagnoses | Site |
|---------------------------------------|--|----------------|--|--|
| Bland-Sutton ⁴⁵ | Indian monitor, <i>Varanus dracoens</i> | 1 | Enchondroma | Bones, cervical vertebrae, humeri, metacarpals, hyoid |
| Cooper ⁴⁶ | Gila monster, <i>Heloderma suspectum</i> | 1 | Melanoma | Tail, subcutis (invasive) |
| Frye and Dutra ⁵⁰ | <i>Anolis carolinensis</i> | 1 | Reticulum cell sarcoma | Mandibular fold |
| Heller (cited elsewhere) ⁷ | <i>Lacerta muralis</i> | Several | Papilloma | Skin, inguinal region |
| Koch ⁴⁹ | <i>L. agilis</i> | 1 | Papilloma | Head, frontal, parietal, and occipital regions; thorax |
| Schlumberger and Lucké ⁷ | Tegu, <i>Tupinambis nigropunctatus</i> | 1 | Squamous cell carcinoma | Gingiva |
| Schwarz ⁴¹ | Tegu, <i>Tupinambis teguixin</i> | 1 | Squamous cell carcinoma | Skin, forefoot |
| Stolk ³⁹ | <i>Lacerta agilis</i> | 7 | Carcinoma planocellulare (squamous cell carcinoma) | Skin |
| Stolk ⁴⁷ | <i>Iguana iguana</i> | 2 | Hepatoma | Liver |
| Stolk ⁴⁸ | <i>Lacerta viridis</i> | 1 | Multiple osteomas | Vertebrae, caudal |
| Zwart and Harshbarger ⁴² | East Indian water lizard, <i>Hydrosaurus amboinensis</i> | 1 | Lymphoblastic lymphoma | Disseminated |
| — | Malayan monitor, <i>Varanus salvator</i> | 1 | Generalized lymphomatosis | Disseminated |

MALIGNANT -

TENDING TO PRODUCE DEATH OR DETERIORATION

EP. TENDING TO INFILTRATE, METASTASIZE AND TERMINATE FATALLY.

METASTASIS -
(METASTASIZE)

TO CHANGE. TRANSFER OF A DISEASE PRODUCING AGENCY FROM THE SITE OF DISEASE TO ANOTHER PART OF THE BODY.

CANCER -

A MALIGNANT TUMOR OF POTENTIALLY UNLIMITED GROWTH THAT EXPANDS LOCALLY BY INVASION AND SYSTEMICALLY BY METASTASIS.

BENIGN -

OF A MILD CHARACTER (tumor)

FIBROMA - a benign tumor consisting mainly of fibrous tissue.

TABLE 3

Summary of Spontaneous Neoplasms Reported in Turtles (Chelonia)

| Authors | Species | No. of animals | Diagnoses | Site |
|--|--|----------------|---------------------------------------|--|
| Cowan ²¹ | Ceylon terrapin, <i>Geomyda tringa</i> | 1 | a. Carcinoma | Thyroid, meta- static to medi- astinum |
| | | | b. Squamous cell carcinoma | Foot |
| - | Black side-necked turtle, <i>Pelusios sublineiger</i> | 1 | Carcinoma | Stomach, meta- static to kid- neys |
| Ippen ²² | Box tortoise, <i>Terrapene carolina</i> | 1 | Adenocarcinoma | Kidney, meta- static to liver |
| - | Greek land tortoise, <i>Testudo hermanni</i> | 1 | Lymphoblastic lymphosarcoma | Disseminated |
| - | Ornamental tortoise, <i>Chrysemys picta</i> | 1 | Carcinoma | Thyroid |
| Nigrelli and Smith ²⁴ | Green sea turtle, <i>Chelonia mydas</i> | Several | Papilloma; fibro- epithelial tumor | Skin |
| Pick and Poll ²⁴ | <i>Platemys geoffroy- ana</i> | 1 | Adenoma | Thyroid |
| Schlumberger and Lucké ⁷ | Musk turtle, <i>Ster- nothaerus odoratus</i> | 2 | Papilloma | Skin |
| Smith and Coates ²³ | <i>C. mydas</i> | 4 | Papilloma; fibro- epithelial tumor | Skin |
| Smith et al. ²² | <i>C. mydas</i> | Many | Papilloma | Gall bladder |

epithelium = tissue covering a free surface or
 epithelial = lining a tube or cavity -
 one or more layers of cells
 forming a sheet.

papilloma = a benign tumor resulting from an
 overgrowth of epithelial tissue on papillae of
 vascularized connective tissue of skin and other
 organs that forms projections or ridges

papilla = one of the vascular protuberances of the
 dermal layer of the skin extending into the
 epidermal layer and often containing tactile
 corpuscles.

cutaneous = of or relating to the skin; existing on
 or affecting the skin.

papillary = of, relating to, or resembling papilla

TABLE 4
Neoplasms in Snakes on File at the Registry of Tumors in Lower Animals (Smithsonian Institution)^{1,4}

| RTLA no. | Contributor | Species | Source | Site | Diagnosis |
|----------|--|---|--|------------------------|-----------------------------|
| 95A | L. Karstad | Garter snake, <i>Thamnophis sirtalis</i> | Field collected (Ontario) Laboratory | Skin | Fibropapilloma |
| 95B | L. Karstad | <i>T. sirtalis</i> | | Testis | Sertoli cell tumor |
| 378 | L. A. Griner (cited elsewhere) ⁴ | Timber rattlesnake, <i>Crotalus horridus</i> | San Diego Zoo | - | Lymphoblastic leukemia |
| 379 | L. A. Griner (cited elsewhere) ^{4,5} | <i>Rhinoceros viper</i> , <i>Bitis nasica</i> | San Diego Zoo | - | Lymphosarcoma |
| 441 | H. Trebbin (cited elsewhere) ^{1,7} | Tiger python, <i>Python molurus</i> | - | Mouth | Adenoamcioblastoma |
| 465 | D. Small | Corn snake, <i>Elophich gularis</i> | - | - | Chondrosarcoma |
| 478 | R. E. Reed and G. Migaki | <i>guttate</i> California king snake, <i>Lampropeltis</i> <i>getulus</i> | Arizona, Senora Desert Museum | Behind heart | Undifferentiated sarcoma |
| 486 | H. C. Orr ⁶ | Timber rattlesnake, <i>Crotalus horridus</i> | - | Skin, back | Fibrosarcoma |
| 498 | R. B. Northway | <i>Boa constrictor</i> | - | Skin | Epidermal papilloma |
| 507 | E. Elkan ⁴ | Everglade snake, <i>Elophich obsoleta</i> <i>rossi</i> | Privately owned | Skin | Malignant melanoma |
| 508 | R. L. Snyder (cited elsewhere) ^{1,5} | <i>Rhinoceros viper</i> , <i>Bitis nasica</i> | Philadelphia Zoo | - | Granulocytic leukemia |
| 560 | V. Lance | Cobra, <i>Naja naja</i> | Hong Kong snake dealer | Metastatic to liver | Leiomyosarcoma |
| 588 | B. L. Bierge | <i>Boa constrictor</i> | Youth science Institute | - | Fibrosarcoma |
| 634 | P. Zwart | Garter snake, <i>Thamnophis sirtalis</i> | Royal Rotterdam Zoo | Abdomen | Cholangioma |
| 721 | R. Ippen ⁵ | Water moccasin, <i>Agkistrodon piscivorus</i> | - | - | Fibroma molle |
| 722 | R. Ippen ⁵ | Indian striped adder, <i>Natrix stolickei</i> | - | - | Hemangioblastoma |

TABLE 5

Neoplasms in Lizards on File at the Registry of Tumors in Lower Animals (Smithsonian Institution)^{1,4}

| RTLA no. | Contributor | Species | Source | Site | Diagnosis |
|----------|-------------------------|--|----------------------|---|-----------------------|
| 291 | P. Zwart ^{2,3} | East Indian water lizard, <i>Hydrosaurus amboinensis</i> | Amsterdam Zoo | Diffuse - liver, heart, lungs, kidney, spleen | Lymphoblastic |
| 460 | P. Zwart | <i>Iguana iguana</i> | - | Ovary (in teratoma) | Adenocarcinoma |
| 461 | P. Zwart ^{2,3} | Malayan monitor, <i>Varanus salvator</i> | Amsterdam Zoo | - | Lymphosarcoma |
| 462 | P. Zwart | Two-flopped chineloan, <i>Chamaeleo dilepis</i> | - | Liver | Hepatoma |
| 482 | J. Kridler | Emerald lizard, <i>Lacerta viridis</i> | Louisiana snake farm | Head | Epidermal papilloma |
| 633 | P. Zwart | African sungazer lizard, <i>Cordylus polyzonus</i> | - | Throat | Thyroid adenoma |
| 635 | P. Zwart | Nile monitor, <i>Varanus niloticus</i> | Captive | Heart, lung, adrenal, stomach, intestine | Plasma cell tumor (?) |
| 719 | R. Ippen ^{2,5} | Malayan monitor, <i>Varanus salvator</i> | - | - | Lymphoma |
| 720 | R. Ippen ^{2,5} | Tegu, <i>Tupinambis Tupinambis rufescens</i> | - | Liver | Hepatoma |

TABLE 6

Neoplasms in Turtles on File at the Registry of Tumors in Lower Animals (Smithsonian Institution)^{1,4}

| RTLA no. | Contributor | Species | Source | Site | Diagnosis |
|----------------|---------------------------|--|-------------------------|------------------------------------|---|
| 12 | <u>G. H. Waddell</u> | <u>Green sea turtle, <i>Chelonia mydas</i></u> | <u>Florida Keys</u> | <u>Head</u> | <u>Fibropapilloma (Figures 2 and 3)</u> |
| 121 | <u>A. C. Smith</u> | <u><i>C. mydas</i></u> | <u>Hilo Bay, Hawaii</u> | <u>Tail</u> | <u>Fibroma (2 cases)</u> |
| 651 | <u>R. M. Overstreet</u> | <u><i>C. mydas</i></u> | <u>Florida Keys</u> | <u>Tail</u> | <u>Fibropapilloma</u> ← |
| 654 | P. Zwart | Florida softshell, <i>Trionyx ferox</i> | - | Muscle, kidney, heart, liver, lung | Lymphoreticular neoplasm |
| 716 | R. Ippen ^{2,5} | Box tortoise, <i>Terrapene carolina</i> | Berlin Zoo | Kidney, metastatic to liver | Renal carcinoma |
| 717 | R. Ippen ^{2,5} | Greek land tortoise, <i>Testudo hermanni</i> | Private owner | Widely disseminated | Lymphoblastic lymphosarcoma |
| 718 | R. Ippen ^{2,5} | Ornamental tortoise, <i>Chrysemys picta</i> | Laboratory (imported) | Parathyroid gland | Adenoma |
| 970 | E. L. Frye ^{6,9} | Red-footed tortoise <i>Geochelone carbonaria</i> | - | Parathyroid gland | Parathyroid adenoma |

TABLE 7
 Reptile Neoplasms on File in the Registry of Veterinary Pathology at the Armed Forces Institute of Pathology

| Case no. | Species | Contributor | Age | Sex | Site | Diagnosis |
|----------|--|---|-------------|-----|---|--|
| 1 | Palestine viper, <i>Vipera palestinae</i> | P. O'Connor Staten Island Zoo | 10 years | F | Possibly bile duct origin | Adenocarcinoma |
| 2 | Python | Nat. Zool. Park | 50-60 years | - | Skin of trunk | Malignant melanoma (Figure 1) |
| 3 | Giant python | Nat. Zool. Park | - | - | Skin of trunk | Malignant melanoma, widespread metastases |
| 4 | Canebrake rattlesnake | F. O'Connor Staten Island Zoo | 9 months | - | Pancreas | Adenocarcinoma |
| 5 | Timber rattlesnake | L. A. Griner, San Diego Zoological Gardens (cited elsewhere) ^{4*} | - | - | Lung, intestine, liver, kidney, spleen, pan- creas, heart | Malignant lymphoma, leukemic |
| 6 | European pond turtle, <i>Emys orbicularis</i> | Nat. Zool. Park | 18 years | F | Intermandibular space, metastatic to liver | Squamous cell carcinoma |
| 7 | Indian python | Nat. Zool. Park | 7 years | M | Liver, metastatic; primary undetermined | Adenocarcinoma, mucinous, cystic |
| 8 | Rhinoceros viper | San Diego Zool. Gardens | - | - | - | Malignant lymphoma |
| 9 | African black cobra | J. R. Wadsworth ¹⁰ | 10 years | - | Dorsal aspect of spinal column | Osteochondroma |
| 10 | Puff adder | P. O'Connor Staten Island Zoo | 3 years | F | Primary undetermined, metastatic to liver, intestine, and kidney | Adenocarcinoma |
| 11 | Pine snake, <i>Pituophis melanoleucus</i> | H. A. Ball ¹⁴ | 6 years | M | Mouth, labial fold | Melanosarcoma |
| 12 | <i>P. melanoleucus</i> | H. A. Ball ¹⁴ | 6 years | F | Skin of head and tail, metastatic to abdomi- nal cavity and liver | Melanosarcoma |
| 13 | <i>Python reticulatus</i> | P. O'Connor Staten Island Zoo | 15 years | F | Cloaca | Transitional cell carcinoma |

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