

A 6-YEAR SURVEY OF EQUINE DERMATOLOGIC  
CONDITIONS IN OKLAHOMA WITH SPECIAL  
REFERENCE TO ALLERGIC DERMATITIS

By

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## CHAPTER I

### INTRODUCTION

The equine population of Oklahoma has steadily increased over the last few years and will continue to do so with the recent passage of parimutuel horse racing. Oklahoma horsemen spend over 48 million dollars annually for veterinary services and supplies. Oklahoma is presently second in the nation in the number of registered Quarter Horses and is within the top five states in the total number of horses (1).

The total number of equine cases processed by the Oklahoma Animal Disease Diagnostic Laboratory (OADDL) from January 1, 1976 through 1981 has increased steadily. Cases involving histopathologic examination of skin biopsies has increased at a moderate rate during this time period. The percentage of dermatology cases diagnosed by histopathology during this time period has dropped from 15.2% during the first year to approximately 5% during the next 5 years (Table I).

Survey reports contribute to the recognition of geographic differences in incidence and serve to compare the consistency of reporting among pathology laboratories as well as within a laboratory from year to year. Reports of surveys involving histologic diagnoses of equine dermatologic diseases are rare in the literature. This survey, which is compiled from the histologic diagnoses of postmortem examinations and equine skin biopsies submitted to OADDL from January 1, 1976 through 1981, will provide needed information for the industry, veterinary

TABLE I  
TOTAL NUMBER OF EQUINE DERMATOLOGY CASES  
DIAGNOSED BY HISTOPATHOLOGY AND TOTAL  
NUMBER OF EQUINE CASES

Year	Number of Equine Dermatology Cases Diagnosed by Histopathology	Total Number of Equine Cases	Percent
1976	40	264	15.2
1977	66	1282	5.1
1978	72	1524	4.7
1979	88	1614	5.5
1980	90	1892	4.8
1981	<u>118</u>	<u>2165</u>	5.5
Totals	474	8741	

practioners and veterinary pathologists.

The purposes of this investigation were:

1. To establish seasonal, age, breed, and sex incidences of specific equine skin diseases.
2. To re-examine a significant number of original slides for the presence of microfilariae of Onchocerca sp. in cases diagnosed as allergic dermatitis.
3. To examine additional sections of tissue from those cases diagnosed as allergic dermitis in order to determine if multiple tissue sections taken at various depths would alter the histopathologic diagnosis.
4. To review the literature and state the current concepts regarding each major category of equine skin disease.
5. To compile this information and present it as useful and meaningful data.

## CHAPTER II

### REVIEW OF THE LITERATURE

#### Introduction

In terms of bulk, skin is the largest organ of the body. The skin has many functions including; acting as a barrier to foreign substances, retaining body fluids, housing receptors for tactile, heat, cold and pain sensations. Dermatologic disease may be the result of conditions which affect the skin primarily or may result from secondary problems that develop in other organs.

The skin consists of 2 layers: the epidermis, a keratinized stratified squamous epithelium that serves as the protective horny layer of the skin, and the dermis, an intricately woven feltwork of collagen, elastic and reticulum connective tissue fibers. Hair follicles, sweat and sebaceous glands, blood and lymph vessels, and nerves are embedded at various levels throughout the dermis.

According to Talukdar (8),

The skin of the horse is characteristic in several ways including:

1. Horse hair is distinguished by the rectangular medullary cells separated by prominent intercellular substance.
2. Hairs occur singly as in cattle rather than in groups typical of carnivores, swine, and smaller ruminants.
3. Branched sebaceous glands, distributed over the entire surface of the body, are the largest of the domestic animals with the exception of the dog (p. 2367).

This literature review will pertain only to those diseases of equine skin that were diagnosed by histopathologic examination at

OADDL from January 1, 1976 through 1981. It is not intended to cover the total subject matter of equine dermatology but to briefly cover etiologies, predilections and current concepts of major disease conditions of equine skin that were diagnosed at the OADDL.

### Neoplasms

Retrospective studies of equine neoplasms have been reported in the United States (2, 3, 4), England (5, 6), and Australia (7).

#### Neoplasms Originating from Connective Tissue

Sarcoid is one of the most frequently occurring tumors in the equine species and has been reported from various parts of the world (3, 6, 7, 11). Jackson described the tumor in 1936 and proposed the term "equine sarcoid" in order to distinguish the growth from granuloma, papilloma, fibroma and fibrosarcoma (11). The histologic diagnosis of these growths can present problems, if as believed by some authors, they are distinct and separate entities from fibromas. Fibromas are collagen producing neoplasms of connective tissue origin while sarcoids, although they have a similar fibroblastic component, also have an epithelial component (8). Difficulties occur in the diagnosis of sarcoids when ulceration or infection leads to loss of the epithelial component, or when the fibroblastic component predominates. Differentiation of these two types of growths are often made on the basis of the following criteria:

1. Most fibromas are recognized surgically as those that "shell out" and histologically as having well demarcated edges; whereas sarcoids infiltrate adjacent normal tissue resulting in a gradual

transition to normal tissue.

2. Fibromas have no epithelial component, whereas sarcoids by definition, have an epithelial component. The rete pegs of sarcoids often extend a considerable distance into the fibrous component. Very short rete pegs are seen occasionally in fibromas but they are rarely more than 20 cells in length and involve only a very small proportion of the total surface.

3. The relationship of the superficial layer of fibroblasts to the basement membrane of the epithelium or rete pegs is such that, in sarcoids, a large proportion of the cells are arranged at right angles to the membrane producing a palisading effect. This alignment is never seen in fibromas.

4. In cases with an ulcerated epithelial surface, the nature and arrangement of the fibers can be used to distinguish the tumors. In sarcoids the fibers appear to be of uniform development, being either all mature or immature with a tendency for adjacent fibers to be straight and parallel with each other. The sarcoid is the more vascular of the two and on occasion the organization of fibers and vessels resembles that of granulation tissue. In fibromas the fibers are of variable maturity, are irregular in direction, and are often randomly arranged. In their most developed form, these fiber components often appear as two foci of plump cells separated by a variable distance and running between the two are fibers of a more mature nature (6).

Based on these criteria, Baker found 44 fibromas and 16 sarcoids in a histologic survey of 244 tumorous growths from 155 horses (6). Many other authors doubt that a clear line can be drawn between equine sarcoid and other fibrous masses of the skin on the basis of histologic

criteria alone (6). This becomes evident as the incidence of sarcoid and fibroma in various surveys is examined. Studies at Purdue University found 215 neoplasms from 635 biopsies; of the neoplasms there were 103 sarcoids and 5 fibromas (2). Another survey examined 282 equine neoplasms and found 111 sarcoids and did not list any fibromas (3).

Evidence indicates that equine sarcoid has an infectious etiology. Bovine papilloma virus (BPV) has been incriminated as the etiologic agent, but growths produced by this virus are not always identical to naturally occurring sarcoids. BPV-induced tumors regress spontaneously, whereas naturally occurring sarcoids normally do not (9). Ragland and Spencer (10) reported that BPV-neutralizing antibodies were not detectable in horses with spontaneous tumors, while antibodies were produced by horses with BPV-induced tumors.

Cheevers (9) reported that malignant tumors were induced in an Arabian foal affected by combined immunodeficiency. The foal was inoculated intradermally with Mcl-tumor cells that were originally cultured from a spontaneously occurring equine sarcoid. A cell line (T-77-4) was established by explantation of the Mcl-tumor that had been induced in the Arabian foal. A virus that had the morphologic and biochemical characteristics of "C-type" retroviruses was isolated from the T-74-4 cell line.

Equine sarcoid was transferred between naturally affected and nonaffected horses by transplanting whole sarcoid tissue, by inoculating scarified skin with minced sarcoid suspension and with cell-free supernatant fluid. Inoculation by scarification was the only successful route of infection since new growths did not occur at any subcutaneous or intradermal inoculation sites (10).

### Squamous Cell Carcinoma

Squamous cell carcinoma is a malignant tumor of epidermal origin that may occur anywhere but has a predilection for areas close to body openings, such as eyelids, lips, nose, vulva, prepuce, and penis. It is particularly prone to occur on unpigmented skin. This tumor rarely arises in normal skin and it is usually preceded by solar keratosis, by carcinoma in situ or by keratosis due to chemicals or ionizing radiation (13). Squamous cell carcinoma has also been reported to develop from papillomas (51). Microscopically, squamous cell carcinomas arise from the prickle cell layer of the epidermis. The presence of these neoplastic prickle cells with intercellular bridges is a useful diagnostic criterion (26). Smegma from the prepuce has been suggested as an etiologic factor in the development of squamous cell carcinoma of the penis. When injected into mice, equine smegma produced papillomas, squamous cell carcinomas and fibrosarcoma at the site of application 36 to 423 days postinjection (14, 15). Repeated trauma and persistent phimosis has also been suggested as a cause of this neoplasm when it is found on the penis (16).

Registry records of equine neoplasms seen at Kansas State University from 1961 through 1971 documented 58 squamous cell carcinomas with the following distribution: eye and adnexa, 19 (32.6%); female genitalia (anus, vulva, and clitoris), 7 (12%); prepuce, 16 (27.3%); glans penis, 10 (17.0%); and head, 6 (10.3%) (17). In this study, of 7 squamous cell carcinomas of the anus, vulva and clitoris, 4 were in pintos. The mean age of horses with squamous cell carcinomas was 12.4 years. A survey report from Purdue University found squamous cell



carcinoma to be the second most common neoplasm affecting horses. They reported a higher incidence in the male than in the female and a mean age of 12 years (2).

### Melanoma

Melanoma is a common equine tumor, especially of older gray horses. Approximately 80% of gray horses over 15 years of age have melanotic growths (18). While melanomas are very rare in horses under 6 years of age, congenital malignant melanoma has been reported in a foal (19). No clear pattern seems to exist between amount of melanin present in the tumor and the degree of malignancy. Histologically, melanomas present an array of histologic appearances including patterns characteristic of neoplasms originating from both epithelial and mesenchymal cells. Both cell types may be seen within the same tumor mass (20).

In one retrospective study melanomas were found principally in males (6 males, 2 females, 1 unknown). The average age of horses with melanoma in this study was 8.3 years (2). Another survey also found a definite predisposition for males and Thoroughbreds (3). Both surveys were taken from, "all cases of equine neoplasia presented" in a 4 year and a 10 year period respectively and thus, were not limited to dermal neoplasms.

### Cutaneous Papilloma

Cutaneous papillomas are circumscribed epidermal growths of various sizes and shapes which may be congenital but are usually acquired. They are most often found on the lips, abdomen and inner surface of the ears in young horses 9 to 15 months of age. They appear as small, benign, single or multiple, horny masses which usually do not enlarge once they

mature. The causative agent of equine papillomatosis is a virus which is usually species specific, although transmission studies have been reported that are indicative of various degrees of infectivity across species lines (21).

A retrospective study of neoplasms in Equidae at the Purdue Diagnostic Laboratory found 13 (5.5%) papillomas in 236 cutaneous neoplasms examined histologically (2). A survey from England reported 11 cases of cutaneous papilloma from 244 tumorous growths; most of these were found on the legs; some were present on the ventral body wall and in the region of the penis (6).

Other neoplasms identified in the OADDL survey included neurofibroma, hemangioma, neuroma, cutaneous lymphosarcoma, neurilemmal cell tumor, sweat gland adenoma, sweat gland adenocarcinoma and sebaceous cell adenocarcinoma. Most of these neoplasms are rare in the equine but many have been reported in the literature (22, 23, 24, 25, 26, 27, 33). Reports of sweat gland adenoma and sweat gland adenocarcinoma in the equine could not be found in the literature.

#### Equine Cutaneous Mastocytoma (Mastocytosis)

Both reactive and neoplastic types of mast cell processes exist in the tissues of animals. The term mastocytosis is frequently used to refer to the reactive or hyperplastic process as well as to obviously malignant, multifocal mast cell neoplasia, especially if the cutaneous neoplasm is accompanied by a mast cell leukemia. Even though this condition in the horse appears to be more hyperplastic than neoplastic, the term mastocytoma is probably preferable (32).

The lesions consist of variably-sized aggregates of mast cells

with eosinophils, necrosis of collagen and dystrophic mineralization. The most common form is a single 2 to 20 cm cutaneous nodule on the head, neck or distal extremities. The surface of the nodules may be normal in those lesions restricted to the dermis and hairless or ulcerated in more superficial lesions. The incidence is 5:1, males versus females, with an age range of 1 day to 15 years (28). The etiology of equine mastocytoma is unknown and attempts to transmit the disease have been unsuccessful. A case of generalized cutaneous mastocytosis characterized by multiple elevated nodules of mast cells in the skin and basophil hyperplasia in the bone marrow of a newborn foal has been reported (29).

Surveys reporting incidence of equine mastocytoma were not found in the literature.

#### Cutaneous Habronemiasis

Cutaneous habronemiasis (eosinophilic granuloma) usually occurs in conjunction with skin injury such as abrasions, wounds, fungal infections, sarcoids, etc. and appears more frequently where the horse is unable to keep flies from the wound. The disease is primarily one in which infestation with the 3rd stage larvae of Habronema and/or Draschia spp. stimulates the formation of excessive granulation tissue in exposed wounds. Horses of all ages are susceptible but adult horses are more commonly affected (30). Most of the lesions of cutaneous habronemiasis occur in the Spring and Summer when the intermediate hosts are common.

Eggs of Habronema muscae, Habronema microstoma and Draschia megastoma hatch in equine manure and are ingested by the developing

maggots of Musca domestica or Stomoxys calcitrans. The larval forms of habronema and draschia mature to the infective (3rd) stage about the time the adult fly emerges from the puparium. The larva are then passed from the proboscis of the fly into open wounds upon which the flies are feeding. Presence of the larvae in the tissues results in local inflammatory changes and the development of extensive granulation tissue.

One study, in which practicing veterinarians in Northern Queensland were encouraged to submit material from all proliferative and/or ulcerative lesions, found 9 cases of primary habronemiasis from 150 lesions examined (31).

#### Nodular Necrobiosis

This disease of unknown etiology is characterized by degeneration of collagen with marked infiltration of the surrounding connective tissue with eosinophils. The disease usually occurs during the warmer months of the year and hypersensitivity to insect bites has been suggested as a possible etiology even though there is no real evidence to substantiate this. The cutaneous lesion consists of multiple nodules .5 to 5 cm in diameter usually occurring on the lateral surfaces of the neck, withers, and on the back. These nodules are usually covered by an intact normal epithelium and are not associated with a pruritic reaction (32). Many horses have a complete regression of the lesions over a period of 3-6 months without treatment (27). Reports of incidence could not be found in the literature.

### Onchocercal Filariasis (Onchocerciasis)

Onchocercal filariasis is a common cause of blindness and skin disease in man and horses as well as several other species (34, 35). The disease in horses is characterized by a recurrent seasonal pruritus and scaly alopecia affecting mainly the ventral midline, chest, withers, neck and face; ocular lesions similar to those of periodic ophthalmia have also been reported (36).

Onchocerca cervicalis is a gray-white, threadlike nematode. Males are 6-7 cm long and 70-100 um thick. Microfilariae are 200-400 um long and 4-5 um in diameter. The life cycle begins when noninfective microfilariae are ingested from the dermis by biting midges of the genus Culicoides. Development to the infective larval stage takes about 25 days in the thoracic muscles of the midge. The infective larvae are then transmitted back into the dermis of the horse by the bite of the infected midge. These infective larvae then migrate to the funicular portion of the ligamentum nuchae where they mature. Microfilariae are produced by these newly matured adults and migrate to the skin allowing the cycle to continue.

Onchocerca cervicalis has a world wide distribution with a high prevalence of infection in many countries. Surveys reporting percentage of infection greater than 75% of the equine population include: Hungary (37); Japan (38); Austria (39). Two separate surveys in England found infection rates of 14 and 23% of the horses examined (40, 41).

In a survey of 282 slaughtered horses in Australia, adult Onchocerca sp. in the ligamentum nuchae were found in 80%. The highest prevalence reported has been in surveys conducted in the United States: 24 infected out of 25 sampled (96%) in New York (43); 77% of those

surveyed in the Midwest (44); 48 infected out of 100 surveyed in the Western United States (45).

Microscopically, microfilariae tend to occur in nests just beneath the epidermis or surrounding adnexal structures. The only lesions seen in sections of skins containing Onchocerca cervicalis microfilariae that were not seen in uninfected skin were small accumulations of lymphocytes, plasma cells and occasionally, eosinophils surrounding the smaller blood vessels in the upper dermis (45).

Finding microfilariae in horses without lesions was best explained by the fact that the microfilariae of Onchocerca volvulus produced an inflammatory reaction only when they were dead (46, 47, 48). Presumably the same would hold true for Onchocerca cervicalis. In man, the life span of microfilariae is of the order of 1 to 3 years (49). Unless premature death of the microfilariae is caused by factors presently unknown, signs would not be expected until 1 to 3 years after infection had taken place, explaining why few cases are seen in young animals.

#### Allergic Dermatitis

The most common cause of pruritic alopecia is an allergic dermatitis caused by hypersensitivity to the bite of any of several species of biting gnats of the genus Culicoides (28). The disease occurs during the warmer parts of the year and has many different names. In France it is known as "Summer sores", in India "lichen tropicus", in the United States "microfilarial pityriasis", in Australia "Queensland itch", in Japan "Kasen disease", in Israel "allergic urticaria", in Germany "summer eczema", and in the United Kingdom "sweet itch" (49).

Culicoid gnats are members of the family Ceratopogonidae. They are generally 1-3 mm long with large, dark spots on the costal border of the wings and a thorax which is humped over the head. Habitats include fresh or salt water, tree holes, decaying plant materials, moist adobe and sandy or alkaline soils. Adult gnats are most active when there is little or no breeze and when the temperature is over 50°F. Because of their immense numbers, culicoid gnats may have been responsible for the lack of early development of the southern areas along the Atlantic seaboard (28).

Early changes observed during microscopic examination of equine skin affected by allergic dermatitis include dilatation and engorgement of the smaller blood vessels and capillaries of the upper dermis. Varying degrees of serous effusion with some infiltration of leukocytes and eosinophils results in the separation of collagen fibers. The epidermal layer becomes thickened due primarily to parakeratotic cells. These cells are soft and adhere together in lamellae with air spaces between them and do not have the dry scruffy appearance of the horny cells of hyperkeratosis which is seen in more chronic lesions. The interpapillary processes often become elongated with branching of their bases which may result in fusion. As the lesion progresses a decrease in cellular infiltration and edema is usually observed along with early evidence of mild fibrosis. The cellular infiltrate, especially eosinophils, tends to remain for long periods. In chronic cases of the disease, extensive fibrosis, hypertrophy of the epidermis and marked hyperkeratosis are evident, resulting in accentuation of skin folds on the crest, withers and rump (50).

Examination of more than 600 horses in Queensland revealed that

about 32% of the animals had evidence of allergic dermatitis (50). An English survey of equine dermal disease reported 127 cases of "sweet itch" from 935 diseases of the skin (5).



## CHAPTER III

### GOALS AND APPROACH

The objective of this survey was to record the incidence of specific equine skin diseases diagnosed by histopathology from case submissions to the OADDL over a 6 year period. In addition, cases originally diagnosed as allergic dermatitis were re-examined histologically to determine if the original diagnosis would have been affected had the stained tissue section been taken at a different depth in the original tissue sample submitted.

### Materials and Methods

The 474 equine dermatology cases for this study were submitted to the OADDL over a 6-year period from January 1, 1976 through 1981. The vast majority were submitted as skin biopsies from veterinary practitioners in Oklahoma. A few cases were obtained from postmortem examinations performed at OADDL.

Equine dermatology case numbers were retrieved from an IBM 3081-D central processing unit. The computer was instructed to supply all case numbers which had been keyed as skin (condition) and equine (species). These case numbers were then compared to another list supplied by the computer which gave case numbers and diagnosis of all equine diseases for this 6-year period. Those cases found on the general equine disease list that involved skin but were found to be

missing from the equine skin disease list were considered to have been incorrectly keyed and were added to the original equine skin disease list. This final list of case numbers was then used to obtain photocopies from the microfilmed files which contained all of the available information on each case. The cases obtained were classified into categories according to histopathologic diagnoses; data concerning breed, sex, age and anatomic location of each disease category was then compiled and summarized.

Within the cases diagnosed as allergic dermatitis 42 cases were re-examined. These were cases in which the original slide as well as a relatively large amount of the paraffin embedded, fixed tissue remained in the files. This paraffin embedded tissue was sectioned in its entirety at which time 2 to 3 additional slides were prepared from various depths of the tissue. The new slides, as well as the original, were then examined microscopically for the presence of microfilariae.

## CHAPTER IV

### RESULTS

#### Survey of Equine Skin Disease

Major categories of equine skin disease diagnosed by histopathology and the number of cases found in each group from January 1, 1976 through 1981 are contained in Table II. The majority of cases (54.4%) were neoplasms. Allergic dermatitis was the second most common condition (11.8%), while parasitic disease including cutaneous habronemiasis and onchocerciasis combined was third (11.5%). Dermatitis (excluding allergic dermatitis) with adjectives including mycotic, eosinophilic, granulomatous, acute and chronic was fourth in total number of cases (8.4%). Other categories represented included granulation tissue (5.5%), nodular necrobiosis (3.8%), miscellaneous group (2.7%) and mastocytosis (1.9%).

#### Neoplasia

The neoplasia category included 258 cases of which there were: 170 sarcoids (65.9%), 46 squamous cell carcinomas (17.8%), 22 melanomas (8.5%), 10 papillomas (3.9%), and 10 less common equine neoplasms (3.9%). The most commonly diagnosed equine neoplasms are presented in Table 3 along with age range, mean age and sex distribution.

TABLE II  
MAJOR DISEASE CATEGORIES: TOTAL  
NUMBER OF CASES 1976-1981

Disease Category	Number of Cases	Percent
Neoplasia	258	54.4
Allergic Dermatitis	56	11.8
Cutaneous Parasitism	54	11.4
Other Dermatitis	40	8.4
Granulation Tissue	26	5.5
Nodular Necrobiosis	18	3.8
Miscellaneous (one of a kind)	13	2.7
Mastocytosis	<u>9</u>	1.9
Total	474	

TABLE III  
 ACCUMULATED DATA ON COMMON EQUINE  
 NEOPLASMS, OADDL 1976-1981

Neoplasm	Number Found	Age Range (years)	Mean Age (years)	Sex Distribution		
				Male	Female	Not Given
Sarcoid	170	.3 to 15	4.9	78	71	21
Squamous Cell Carcinoma	46	3 to 28	12.4	31	13	2
Melanoma	22	.5 to 17	7.1	9	12	1
Papilloma	10	fetus to 13	6.0	4	4	2

### Sarcoid

Equine sarcoid was the most common neoplastic lesion. These neoplasms appeared mainly in young horses with a definite decrease in incidence with advancing age. More than one half (57.1%) of the sarcoids occurred in horses 5 years old or less. The majority of the cases of sarcoid (69%) were found in the Quarter Horse breed (Table IV). Most sarcoids (66.5%) were seen in the Spring and Summer months including April through September. Sarcoids were found to have no sex predilection when case histories were examined. Many of the histories mentioned multiple tumors but the number of tumors present and exact locations were poorly documented on most case submittal forms. A diagnosis of fibroma was not given in any of the cases reviewed.

### Squamous Cell Carcinoma

Squamous cell carcinomas represented 17.8% of all neoplasms examined and were found in horses of all age groups but were more common in older horses (Table III). Age was included in 36 case histories of which 25 were over 10 years old. This neoplasm was found in several breeds but a higher incidence, relative to the general horse population, was present in the lighter colored breeds (Table IV). Several of the case histories giving Quarter Horse as the breed indicated that the color of the skin was light such as gray, white, etc. No seasonal predilection was present. The neoplasm always occurred near mucocutaneous junctions and there was a marked predisposition for males over females with 31 and 13 cases respectively. The anatomic distribution was: near the eye, 23; male genitalia, 17; near the ear, 2; perineum, 2; vulva, 2.

TABLE IV  
BREED DISTRIBUTION OF COMMON EQUINE  
DERMATOLOGIC CONDITIONS

Condition	QH*	App.	Arab.	TB	TW	Paint	Pony	Mixed	Not Given	Mustang	Total
Sarcoid	107(62.9)**	7(4.1)	12(7.1)	8(4.7)	2(1.2)	10(5.9)	3(1.8)	6(3.5)	15(8.8)	-	170
Squamous Cell Carcinoma	18(39.1)	10(21.7)	-	1(2.8)	-	7(15.2)	3(6.5)	-	7(15.2)	-	46
Melanoma	11(50.0)	-	6(27.3)	1(4.5)	1(4.5)	-	-	1(4.5)	1(4.5)	1(4.5)	22
Papilloma	4(40.0)	2(20.0)	2(20.0)	-	-	1(10.0)	-	-	1(10.0)	-	10
Allergic Dermatitis	35(62.5)	5(8.9)	5(8.9)	2(3.6)	3(5.4)	-	1(1.8)	1(1.8)	4(7.1)	-	56
Onchocercia- sis	12(70.6)	-	2(11.8)	1(5.6)	-	-	-	2(11.8)	-	-	17
Habronemiasis	20(54.1)	3(8.1)	4(10.8)	3(8.1)	-	4(10.8)	-	1(2.7)	2(5.4)	-	37
Nodular Necrobiosis	10(55.6)	2(11.1)	3(16.7)	2(11.1)	-	-	-	1(5.6)	-	-	18
Mastocytosis	2(22.2)	-	5(55.6)	-	-	-	1(11.1)	-	-	1(11.1)	9
Granulation Tissue	20(76.9)	2(7.7)	-	2(7.7)	-	1(3.9)	-	-	1(3.9)	-	26

\*QH - Quarter Horse  
 App. - Appaloosa  
 Arab. - Arabian  
 TB - Thoroughbred  
 TW - Tennessee Walker  
 \*\*Percentage

### Melanoma

Melanomas were the third most common neoplasm accounting for 8.5% of the total neoplasms (Table III). Ages ranged from 6 months to 17 years. Twelve of the cases where age was given in the history occurred in horses 4 years old or less. Breed incidence included: Quarter Horse, 11; Arabian, 6; Thoroughbred, Tennessee Walker, Mustang, Appaloosa cross, and breed not given, 1 each (Table IV). Increased seasonal occurrence was not observed. Case histories indicated 12 were from females, 9 from males and 1 in which the sex was not given (Table III). Anatomic locations were: tail, 6; head, 4; male genitalia, 2; inguinal region, 2; legs, 2; trunk, 4; neck, 1; location not given, 1.

### Cutaneous Papilloma

Papilloma was diagnosed in 10 cases. Age range was from an 8 month fetus to a 13 year old, with 5 cases occurring in horses at least 9 years old (Table III). This neoplasm was found in 4 Quarter Horses, 2 Arabians, 2 Appaloosas, 1 Paint and 1 breed not given (Table IV). The seasonal occurrence was as follows: May, 2; August, 1; September, 1; October, 1; November, 2; December, 3. Cases occurred equally in males and females, with 4 each and 2 cases in which sex was not given (Table III). The head was the location recorded for 5 cases; male genitalia accounted for 3 cases and 2 cases occurred on the leg.

### Miscellaneous Neoplasms

Less common neoplasms were found in 10 cases. These included neurofibroma, hemangioma (two), neurilemmal cell tumor, neuroma, sweat gland adenoma, cutaneous lymphosarcoma, sebaceous cell adenocarcinoma,



sweat gland adenocarcinoma and intradermal inclusion cyst.

#### Cutaneous Mastocytoma (Mastocytosis)

Cutaneous mastocytoma was diagnosed in 9 cases over the 6 year survey. Age range of affected animals varied from 2 months to 17 years with most cases occurring in the 5 to 9 year old category. Arabian was the most commonly affected breed with 5 cases and Quarter Horse was second with 2 cases (Table IV). Most cases occurred in August which had 5; May had 3 and February 1 (Figure 1). The sex ratio was even at 4 males and 4 females with 1 case history not providing the sex of the animal. Some cases were reported as multiple and the anatomic location of lesions appeared to be random.

#### Dermatitis

Dermatitis was the common denominator in 40 cases which did not readily fit into more specific categories. These cases were placed in this "miscellaneous" group on the basis that the histopathologic diagnosis included the word dermatitis, but the comments section either gave the impression that it had an equal chance of being in one of two or more categories or the comments reflected the opinion that it did not belong in any specific established category. These cases were found in animals ranging in age from 6 weeks to 22 years with a good distribution within this range. Quarter Horse was the most commonly represented breed in this category. Distribution was fairly uniform with a slight depression in the number of cases submitted in December and January and a slight peak in August and September. There was a moderate predilection for males with 22 cases to 15 cases in females.

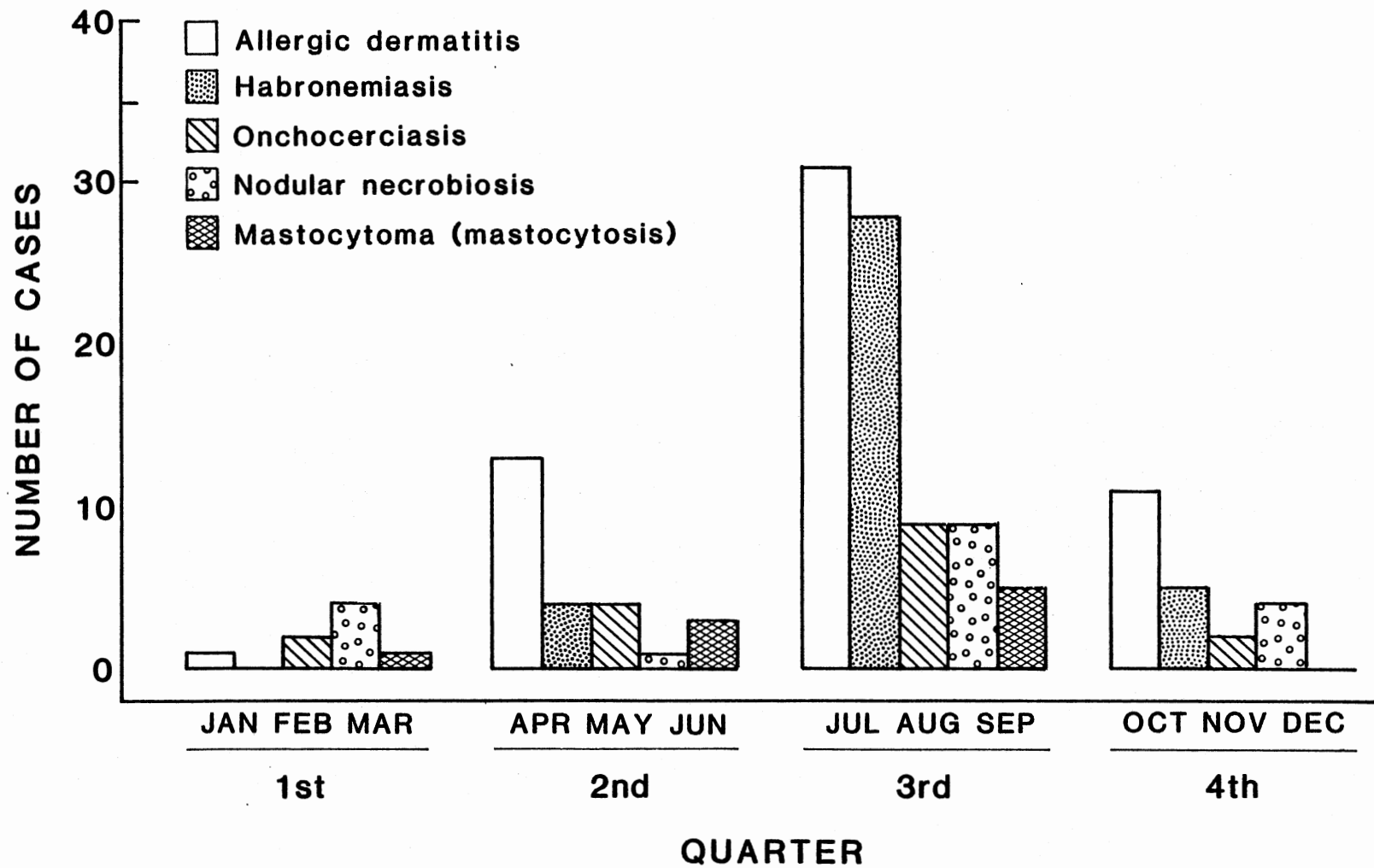


Figure 1. Seasonal Incidence of Some Common Equine Dermatologic Conditions

Three case histories did not include the sex of the animal. Lesions were found in most anatomic locations and commonly involved multiple areas.

#### Allergic Dermatitis

Allergic dermatitis was diagnosed in 56 horses ranging in age from 1½ to 19 years old. The ages were well distributed with 18 of the 43 cases in which age was given being 5 years or less. Quarter Horse was the breed most affected with the other breeds having relatively few cases (Table IV). The majority of cases (31) occurred during the third quarter of the year (July, August, September). The second and fourth quarter combined had approximately the same total number (13 and 11 respectively), as the third quarter. The first quarter had only one case reported in the 6 years covered by the survey (Figure 1). A moderate predilection for males was present with 30 cases involving males, 20 involving females and 6 cases with sex not recorded. Locations were not well documented but most cases seemed to occur on the trunk and neck.

#### Cutaneous Onchocerciasis

Cutaneous onchocerciasis was given as the etiologic diagnosis in 17 cases. The age range was from 4 to 13 years with 12 of the 14 cases in which age was given occurring in horses 8 years or older. Quarter Horse was identified as the breed in 12 of the 17 cases (Table IV). The peak period was July, August and September which accounted for 9 cases. June had 2 cases and all other months had 1 case each with the exception of January and November which did not have any cases reported (Figure 1). There was a predilection for females with 11 cases, while

there were 4 cases in geldings and three cases in which the sex was not given. Most cases involved large areas of the body with clinical signs of alopecia and pruritus noted commonly in the history.

#### Cutaneous Habronemiasis

Cutaneous habronemiasis was diagnosed in 37 cases; 16 in which the parasite was observed histologically and 21 in which the lesion was characteristic but the parasite was not observed. The ages ranged from 1 to 20 years and were well distributed. Quarter Horse was the primary breed reported with many other breeds also represented (Table IV). All cases were submitted in the months of May through December with July, August and September being the peak months (Figure 1). A definite predilection was present for the male with 27 of the 35 cases in which sex was given occurring in stallions or geldings. Many different anatomic locations were involved and several cases listed multiple locations.

#### Nodular Necrobiosis

Eighteen cases of nodular necrobiosis were diagnosed from the biopsy submissions. Age range was 4 to 9 years. Seasonal peaks occurred in July with 6 cases; February, August and December each had 3 cases, March, May and November had one each, no cases were found in the remaining 5 months (Figure 1). Sex ratio was about even with 9 females, 7 males and 2 cases in which sex of the animal was not given. Twelve of the case histories indicated that the lesions were multiple and the remaining 6 listed a single area of the body in which the lesion was found. The 6 cases listing an area of the body did not indicate if the lesion was single or multiple.

### Granulation Tissue

Granulation tissue was the primary part of the histopathologic diagnosis in 26 cases. These animals ranged in age from 3 weeks to 28 years. Quarter Horse was the predominate breed, being reported in 20 cases (Table IV). Cases were diagnosed in each calendar month with August, September and December having the most cases; 3 cases were found in June, 2 each in May and October and 1 case in each of the remaining months. This condition occurred twice as often in males as in females with 16 versus 8 respectively and 2 cases in which the sex of the animal was not given. Eleven cases were reported from the leg and 7 cases from the head. The remaining cases were found on various areas of the body.

### Miscellaneous Category

A miscellaneous category was created for 13 single diagnoses. Diagnoses from this group included: cutaneous amyloidosis, capsule wall, seborrhea, acanthosis (2), keloid (2), cellulitis/vasculitis, hyperplasia of collagen (scar), hyperkeratosis, traumatic necrosis of fat, necrosis and hyalinization of subcutaneous tissue. The case histories revealed an age range of 10 months to 15 years, with most animals being 5 to 12 years old. Ten cases were from Quarter Horses, 1 case from an Arabian and 2 cases did not list the breed. These cases were well distributed with a slight peak in the number of cases during April and May. Sex distribution was equal with 5 cases in males, 6 in females and 2 with the sex of the animal not given. Several anatomical areas were listed as location of lesions in this category.

### Re-examination of Allergic Dermatitis Cases

The allergic dermatitis category contained 42 cases that were re-examined. These cases were selected on the basis that the original slide was present, microfilariae were not reported on the original slide and sufficient paraffin-embedded, fixed tissue remained to provide representative tissue sections from at least 2 deeper levels. Examination consisted of a thorough microscopic search at 250X magnification of both the original slide and 2 to 3 recuts of each case. Microfilariae of Onchocerca spp. were not found in 28 of these cases. Microfilariae of Onchocerca spp. were found in at least 1 of the 2 to 3 recuts of 7 cases (Table V). Microfilariae were also found to have been present in 5 original sections but were not reported as being observed by the examining pathologist (Table VI). Two other cases were observed in which a deeper recut would have greatly increased the accuracy of the diagnosis; one contained evidence of habronemiasis and the other had a sarcoid on deeper sections (Table VII).

TABLE V  
ALLERGIC DERMATITIS CASES WITH MICROFILARIAE  
ABSENT IN ORIGINAL SLIDE BUT PRESENT ON  
RECUTS OF TISSUE

Case No.	Number of Microfilariae Found			
	Original Slide	Recut #1	Recut #2	Recut #3
566	0	1	0	1
15464	0	1	0	0
18553	0	2	1	0
48590	0	1	0	0
50432	0	1	0	-
52031	0	1	0	0
52943	0	1	9	7

TABLE VI  
ALLERGIC DERMATITIS CASES WITH  
MICROFILARIAE PRESENT IN  
ORIGINAL SLIDE

Case No.	Number of Microfilariae Found			
	Original Slide	Recut #1	Recut #2	Recut #3
1046	12	≥ 40	≥ 40	≥ 40
15005	1	0	0	0
16239	4	8	2	0
18248	1	0	0	0
41330	6	0	0	0



TABLE VII  
ADDITIONAL LESIONS OBSERVED ON  
RECUTS OF TISSUE

Case No.	Original Slide	Recuts
8178	Allergic Dermatitis	Sarcoid
35941	Allergic Dermatitis	Habronemiasis

## CHAPTER V

### DISCUSSION AND CONCLUSIONS

#### Discussion

This survey was uncommon in that it compiled all equine dermatologic cases that were diagnosed by histopathology at a diagnostic facility over a significant period of time. Most surveys of diseases of equine skin that have been reported in the literature have dealt with specific areas such as neoplasia (2, 3, 4). Results of this survey reveal some thought provoking information:

Sarcoid was diagnosed 170 times; fibroma was not diagnosed. This is in basic agreement with several surveys from the United States but is not compatible with a survey taken in Great Britain. Many pathologists in the United States apparently consider most mesodermal neoplasms that arise in equine skin as being the same condition and as a consequence they lump them into the classification of sarcoid. On the other hand, there may be an actual difference in incidence of sarcoids versus fibromas in the two countries. One interesting note is that in January, 1983, a tumor removed from the scrotal area of a Thoroughbred was examined at the OADDL and it impressively met the reported histologic criteria of a fibroma. Upon purusing the clinical history of this case it was discovered that the horse originated in Great Britain and had entered the United States 6 months previously.

On close observation, the predilection of squamous cell carcinoma for the male sex in this survey appears to be a direct result of the frequency of genital lesions. If the squamous cell carcinomas occurring in the genital area (penis, prepuce, vulva) are excluded, then the sex ratio becomes approximately 1-to-1. These findings coupled with the marked difference in the quantity of smegma present on the male genitalia versus that found on the female genitalia would help substantiate the reported carcinogenic activity of equine smegma.

The sex predilection observed in cases of cutaneous habronemiasis and exuberant granulation tissue are difficult to explain because a high number of penile lesions was not found in either condition. Well documented surveys of sex predilection for these two conditions could not be found in the literature.

Unlike reports in the literature, sex predilection for males in cases of cutaneous mastocytoma (mastocytosis) was not found in this survey. Arabians were the primary breed in which this condition was diagnosed at the OADDL. This information was based on too few cases to be conclusive by itself, however.

The cases originally reported as being onchocerciasis occurred in 10 females and 4 males. However, the 12 additional cases in which microfilaria of Onchocerca were found on re-examination had an even male-to-female ratio. This could be indicative of a deficient sample size in the original cases of onchocerciasis.

The connection between presence of microfilariae in the dermis of nonreactive versus reactive skin remains unclear. Many possibilities exist including: individual allergenic status, infective microfilariae stimulate a host reaction whereas noninfective larvae do not, only dead

larvae may produce a host reaction, microfilariae of species other than Onchocerca cervicalis may produce a reaction in the horse. Diagnosticians should also realize the inherent problems when they rely only on histopathology for the observation of microfilariae. It would be interesting to calculate the probability of sectioning a microfilaria in a parallel plane conducive to microscopic recognition from a biopsy specimen with randomly arranged microfilariae. My impression would be that for every microfilaria seen, 20 or more would be cut at an angle that would make identification by means of light microscopy difficult.

Microscopic lesions observed in cases of allergic dermatitis are often similar to those of onchocerciasis. Re-examination of 42 cases of allergic dermatitis revealed that the microfilariae of onchocerca are often difficult to find in stained tissue sections. Unobserved microfilariae were found on 5 original slides which had been diagnosed as allergic dermatitis. Of these 5 cases, 3 had numbers of microfilariae which would have been diagnostically significant. The other 2 cases had only one microfilaria in the original and none in the 3 recuts of each case. Seven of 42 cases of allergic dermatitis did not have microfilariae in the original slide but microfilariae were present in recuts of the tissue. Of these 7 cases, only 1 had sufficient numbers of microfilariae in recuts to have been diagnostically important. Two other cases in the allergic dermatitis group had lesions which were obscure on the original slide but pronounced on the recuts. The additional lesion observed in one case was cutaneous habronemiasis and a sarcoïd was present in the other case.

The information obtained from re-examination of the 42 cases of allergic dermatitis indicates that additional tissue samples taken deeper

in the embedded tissue may increase diagnostic accuracy. This procedure would have application in all equine dermatology cases in which histopathology was used as a diagnostic aid.

Investigations such as this may serve as a foundation to encourage further research into specific areas. Re-examination of one category (allergic dermatitis) in this survey points out the importance of careful scrutiny of data found in survey reports. One must consider the method(s) by which diagnoses were made, the chance of human error, differences in interpretation of histopathology and the total number of cases used to arrive at conclusions.

One should bear in mind that the incidence of equine dermatologic conditions reported in this survey is not necessarily the same as that seen by most veterinary practitioners. Many conditions such as melanoma and papilloma are easily diagnosed clinically and histopathologic confirmation is not requested. This and similar situations can create misleading results in survey reports. In this survey for example, only 2 of the 10 cases of papilloma were within the normal 6 to 18 months of age group. The other 8 cases were probably submitted for histopathologic examination only because the age of the animal confused the clinical diagnosis.

#### Conclusions

This survey reinforced some previously reported data on equine dermatologic conditions and contradicted other reports. Re-examination of allergic dermatitis cases emphasized the need for additional tissue sections to obtain a more representative sampling of the lesion.

## BIBLIOGRAPHY

1. Wilkins, W. and Meadows, D. G.: Oklahoma Horse Industry. Extension Note from Oklahoma State University, Oklahoma Horsemen's Association, 1980.
2. Sundberg, J. P., Burnstein, T., Page, E. H., Kirkham, W. W. and Robinson, F. R.: Neoplasms of Equidae. J.A.V.M.A. 170(2): 150-152, 1977.
3. Kerr, K. M. and Alden, C. L.: Equine Neoplasia - A Ten Year Survey. In Proceedings: Am. Assoc. Vet. Lab. Diag. 1974:183-187, 1974.
4. Lauach, J. D. and Severin, G. A.: Neoplasia of the Equine Eye, Adnexa, and Orbit: A Review of 68 Cases. J.A.V.M.A. 170(2): 202-203, 1977.
5. British Equine Veterinary Association Survey of Equine Disease, 1962-1963. Vet. Rec. 177(19):528-537, 1965.
6. Baker, J. R. and Leyland, A.: Histological Survey of Tumors of the Horse, with Particular Reference to Those of the Skin. Vet. Rec. 96(19):419-422, 1975.
7. Miller, R. I. and Campbell, R. S. F.: A Survey of Granulomatous and Neoplastic Diseases of Equine Skin in North Queensland. Aust. Vet. J. 59:33-37, 1982.
8. Talukdar, A. H., Calhoun, M. L. and Stinson, A. W.: Microscopic Anatomy of the Skin of the Horse. Am. J. Vet. Res. 33(12): 2365-2390, 1972.
9. Cheevers, W. P., Roberson, S. M., Brassfield, A. L., Davis, W. C. and Crawford, T. B.: Isolation of a Retrovirus from Cultured Equine Sarcoid Tumor Cells. Am. J. Vet. Res. 43(5):804-806, 1982.
10. Ragland, W. L. and Spencer, G. R.: Attempts to Relate Bovine Papilloma Virus to the Cause of Equine Sarcoid: Immunity to Bovine Papilloma Virus. Am. J. Vet. Res. 29:1363-1366, 1968.
11. Jackson, C.: The Incidence and Pathology of Tumors of Domesticated Animals in South Africa. Onderstepoort J. Vet. Sci. & Anim. Indust. 6:378-385, 1936.

12. Voss, J. L.: Transmission of Equine Sarcoid. *Am. J. Vet. Res.* 30:183-191, 1969.
13. Greer, C. H.: Ocular Pathology, 2nd ed. Blackwell Scientific Publications, London, England, pp. 74-75, 1972.
14. Plant, A. and Kahn-Speyer, A. C.: The Carcinogenic Action of Smegma. *Sci.* 105:391-392, 1947.
15. Roder, A.: Die Operative Behandlung de Neubildungen Am Penis des Pfudes. *Berl. Much. Trreraerzth Wochemchs* 42:17-18, 1926.
16. Pires, A.: Tumors of the Penis in Horses. *Am. Fac. Med. Vet., Univ. La Plata*, 7:127-164; *Abstr. in Vet. Bull.* 17:268-269, 1947.
17. Strattus, A. C.: Squamous Cell Carcinoma in Horses. *J.A.V.M.A.* 168(1):61-62, 1976.
18. Stannard, C.: Equine Medicine and Surgery, 2nd ed. American Veterinary Publications, Santa Barbara, 1972.
19. Hamilton, D. P. and Byerly, C. S.: Congenital Malignant Melanoma in a Foal. *J.A.V.M.A.* 164(10):1040-1041, 1974.
20. Cockerell, G. L. and MacCoy, D. M.: Clinicopathological Manifestations of Selected Neoplasms. *Cornell Vet.* 68:133-150, 1978.
21. Cook, R. H. and Dolson C.: Experimental Transmission of Cutaneous Papilloma of the Horse. *Am. Jour. of Path.* 27:1087, 1951.
22. Newfield, J. L.: Lymphosarcoma in the Horse: A Review. *Can. Vet. J.* 14:129-135, 1973.
23. Theilen, G. H. and Fowler, M. E.: Lymphosarcoma (lymphocytic leukemia) in the Horse. *J.A.V.M.A.* 140:923-929, 1962.
24. Sheahan, B. J., Atkins, G. J., Russell, R. J. and O'Connor, J. P.: Histiolympocytic Lymphosarcoma in the Subcutis of Two Horses. *Vet. Pathol.* 17:123-133, 1980.
25. Adams, O. R.: Lameness in Horses, 3rd ed. Lea & Febiger, p. 269, 1974.
26. Jubb, K. V., Kennedy, P. C.: Pathology of Domestic Animals, 2nd ed. Academic Press, Inc., 1970.
27. Pasco, R. R.: Equine Dermatoses. University of Sydney, The Post-graduate Foundation in Veterinary Science, *Vet. Review*, No. 22, 1981.
28. McMullan, W. C.: Equine Medicine and Surgery, 3rd ed., Vol. II. American Veterinary Publications, Inc., Santa Barbara, CA, 1982.

29. Cheville, N. F., Prasse, K., VanderMaaten, M. and Boothe, A. D.: Generalized Equine Cutaneous Mastocytosis. *Vet. Path.* 9: 394-407, 1972.
30. Blood, D. G., Henderson, J. A. and Radestits, O. M.: Veterinary Medicine, 5th ed. Lea and Febiger, 1979.
31. Murry, D. R., Ladds, P. W. and Campbell, R. S. F.: Granulomatous and Neoplastic Diseases of the Skin of Horses. *Aust. Vet. J.* 54:338-341, 1978.
32. Stannard, A. A.: Selected Topics in Equine Dermatology. Class handout, School of Veterinary Medicine, University of California at Davis, 1977.
33. McMartin, D. N. and Gruhn, K. F.: Sebaceous Carcinoma in a Horse. *Vet. Path.* 14:532-534, 1977.
34. Beaver, P. C. and Orihel, T. C.: Human Infection with *Filaria* of Animals in the United States. *Am. J. Trop. Med. Hyg.*, 14: 1010, 1965.
35. Soulsby, E. J. L.: Helminths, Arthropods and Protozoa of Domesticated Animals, 6th ed. Williams and Wilkins, Baltimore, Md., 1968.
36. McMullan, W. C.: Onchocercal Filariasis. *SW Vet.* 25:179, 1972.
37. Nemeseri, L.: Untersuchungen uber die Haufigkeit von Mikrofilarien in Pferdeaugen and ihre pathologische Bedeutung. *Acta Vet. Acad. Sci. Hung.* 6:109-129, 1956.
38. Sasaki, N., Sato, M. and Sano, K.: Studies on Skin Microfilariasis in Horses. III. Distribution and Seasonal Variation in Numbers of Microfilariae in the Skin and Its Relation to the Parasite of *Onchocerca cervicalis*. *Exp. Rep. Natl. Inst. Anim. Health (Tokyo)* 30:125-137, 1955.
39. Supperer, R.: Filariosen der Pferde in Osterreich. *Wien Tierarztl Monatsschr* 40:193-220, 1953.
40. Mellor, P. S.: Studies on *Onchocerca cervicalis* Railliet and Henry 1910: I. *Onchocerca cervicalis* in British Horses. *J. Helminthol.* 47:97-110, 1973.
41. Mellor, P. A.: Studies on *Onchocerca cervicalis* Railliet and Henry 1910: II. Pathology in the Horse. *J. Helminthol.* 47:111-118, 1973.
42. Riek, R.: Studies on Allergic Dermatitis (Queensland Itch) of the Horse: The Aetiology of the Disease. *Aust. J. Agric. Res.* 5:109-129, 1954.



43. Caslick, E.: Further Study of a Parasite Found in the Ligamentum Nuchae of Equines. Rep. NY State Vet. 32:162-167, 1922.
44. Rabalais, F. C., Eberhard, M. L., Ashley, D. C. and Platt, T. R.: Survey of Equine Onchocerciasis in the Midwestern United States. Am. J. Vet. Res. 35:125-126, 1974.
45. Stannard, A. A. and Cello, R. M.: Onchocerca cervicalis Infection in Horses from the Western United States. Am. J. Vet. Res. 36:1029-1031, 1975.
46. Nelson, G. S.: Onchocerciasis. Adv. Parasit. 8:173, 1970.
47. Nelson, G. S.: The Pathology of Filarial Infections. Helminth. Abst. 35:311, 1965.
48. Rodger, F. C.: The Pathogenesis and Pathology of Ocular Onchocerciasis. Am. J. Ophthal 49:104, 327, 560, 1960.
49. Meller, P. S. and McCaig, J.: The Probable Cause of "Sweet Itch" in England. Vet. Rec. 95:411-415, 1974.
50. Riek, R. F.: Studies on Allergic Dermatitis ("Queensland Itch") of the Horse. Aust. Vet. J. :177-184, 1953.
51. Moulton, J. E.: Tumors in Domestic Animals, 2nd ed. University of California Press, Los Angeles, 1978.

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