

A SURVEY ON NEOPLASIA IN DOMESTIC SPECIES OVER A 40-YEAR PERIOD FROM 1935 TO 1974 IN THE REPUBLIC OF SOUTH AFRICA. VI. TUMOURS OCCURRING IN DOGS

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ABSTRACT

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A survey was carried out on all canine neoplasms recorded in the registration files of the Section of Pathology of the Veterinary Research Institute at Onderstepoort over a 40-year period from 1935 to 1974. The neoplasms were divided and tabulated into 14 groups according to body systems or tissue types.

A total of 3 388 neoplasms were recorded. The 5 most frequently affected body systems were the mesenchymal tissues (33,7%) the skin and adnexa (20,8%) the female genital tract (10,2%), the lymphohaemopoietic tissues (8,9%) and the male genital tract (5,8%). Mastocytomas, the most frequently encountered type of tumour, accounted for 12,7% of all the neoplasms, followed by lymphosarcomas, melanomas, squamous cell carcinomas, basal cell tumours, haemangiosarcomas and histiocytomas.

A variety of mesenchymal tumours were encountered, the most common types being mastocytomas and histiocytomas as well as tumours of vascular, fibrous and adipose tissue origin. The principal cutaneous tumours included basal cell tumours, squamous cell carcinomas, perianal gland tumours and melanomas. Eighty per cent of the neoplasms of the female genital tract were mammary tumours, 50% of which were mixed mammary tumours, whilst the principal neoplasms of the male genital tract involved the testes, of which Sertoli cell tumours were the commonest type. The majority of the digestive tract neoplasms occurred in the oral cavity, the most frequently recorded types being inflammatory epulides and melanomas. Osteosarcomas, neurofibromas and thyroid carcinomas were, respectively, the most frequently encountered neoplasms of the skeletal, nervous and endocrine systems. Pulmonary adenocarcinomas, melanomas and cholangiocarcinomas were the commonest tumours of the lung, eye and liver.

INTRODUCTION

A wide variety of neoplasms are encountered in the canine population. Jackson (1936), in his report on the incidence of the tumours of domestic animals in the Republic of South Africa (RSA), included those occurring in dogs up to 1935. More recently, De Kock (1962) reported on the neoplasms encountered in dogs from the Cape Town district. Since these 2 reports there have been no subsequent, comprehensive reports on the types of neoplasms which can be encountered in dogs in the RSA.

Jackson (1936) recorded the incidence of 72 tumours in dogs over a 15-year period, the most commonly encountered types being transmissible venereal tumours (19% of the total), followed by squamous cell carcinomas and basal cell tumours (11% each). De Kock (1962) reported mesenchymal tissues to be the most commonly affected tissue, followed in order of frequency by the skin, skeletal system, lymphohaemopoietic tissue and the female and male genital tracts. In Italy, the body systems or tissues most commonly neoplastic in dogs from the Milan area were the liver, thyroid glands, respiratory system, lymphoid tissue and the male and female genital tracts (Carrara & Cremagnani, 1964). In the United States of America (USA), Sastry & Tweihaus (1964) recorded lymphosarcomas as the commonest tumours, followed by squamous cell carcinomas, mammary tumours, fibrosarcomas, mastocytomas, lipomas, transmissible venereal tumours and melanomas. Mulligan (1949), also in the USA, noted that the 8 commonest canine tumours were mastocytomas, mixed mammary tumours, perianal gland adenomas, histiocytomas, mammary carcinomas, sebaceous adenomas, lipomas and fibromas.

The purpose of this survey was to report the frequency and site of occurrence of the neoplasms occurring in dogs in the RSA and to compare these findings with those reported elsewhere in the world.

MATERIALS AND METHODS

The data for this survey were obtained from formalin-fixed material submitted by private or state veterinarians from all parts of the RSA to the Section of Pathology of the Veterinary Research Institute, Onderstepoort, over a 40-year period, from 1935 to 1974.

The registration files for each year of the survey and the written reports on each individual tumour were carefully screened, and all cases diagnosed as tumours in all the domestic species were noted and recorded in a separate registration file. The tumours were then subdivided according to species. The canine tumours which are dealt with in this report have been tabulated under 14 tissues or body systems. The details of specific tumours occurring within each body system or tissue or the distribution of certain types of tumours within the different systems have been set out in additional tables.

All the cases recorded as preservation cases within the first 15 years of the survey were routinely recut at 4-6 μ m, stained with haematoxylin and eosin (HE) and examined under the light microscope to verify the diagnoses recorded in the registration files. For the same purpose, selected cases of rare tumours or those with an ambiguous diagnosis recorded within the last 25 years of the survey were also recut and examined microscopically.

Any tumours recorded in the registration files by outdated terms were reclassified and all neoplasms have been tabulated according to the current terminology.

RESULTS

The total 3 388 neoplasms have been tabulated under 14 body systems or tissues, and the number and percentage of the total that each system represents are given in Table 1. The frequency of occurrence of the 23 most commonly encountered tumours is recorded in Table 2. The details of tumours occurring within a particular system or tissue, or the distribution of a specific type of tumour are given in Tables 3-26. There are discrepancies in the total for some systems in Table 1 and subsequent tables. This has arisen because in Table 1 a specific tumour type has been included under only 1 system,

whilst the same tumour type may actually occur within various systems in subsequent tables.

Features of some of the more common or interesting canine tumours are depicted in Fig. 1-36.

TABLE 1 The systemic division of the canine tumours from 1935 to 1974

Numeral	Body system/tissue	Number	Percentage
1	Mesenchymal tissues	1 142	33,7
2	Skin and adnexa	703	20,8
3	Female reproductive system	347*	10,2
4	Lymphoid and haemopoietic tissue	302	8,9
5	Male reproductive system	197	5,8
6	Digestive system	184	5,4
7	Skeletal system	99	2,9
8	Endocrine system	66	2,0
9	Nervous system	58	1,7
10	Eye and adnexa	48	1,4
11	Respiratory system	43	1,3
12	Liver and biliary system	33	1,0
13	Urinary system	25	0,7
14	Undetermined origin	141	4,2
	Total	3 388	100

* This includes the extragenital transmissible venereal tumours as well as those for which the site of origin could not be determined

The systems or tissues most commonly neoplastic included the mesenchymal tissues, the skin, the female reproductive tract, the lymphoid tissue and the male genital tract, which together accounted for 80% of all the tumours (Table 1).

There was no single tumour that constituted an exceptionally high proportion of the canine tumours.

The 6 most frequently encountered neoplasms, in order of frequency, were mastocytomas, lymphosarcomas, melanomas, squamous cell carcinomas, basal cell tumours and haemangiosarcomas. Blood vessel tumours and mammary tumours as groups were the third and fourth most common groups of neoplasms (Table 2.)

The mesenchymal tissue tumours included a variety of different types (Table 3), the most common being the mastocytomas (37,9% of the total 1 142), followed by haemangiosarcomas (12,9%), histiocytomas (11,8%), fibrosarcomas (8,8%) and fibromas (8,7%). Lipomas, haemangiomas and haemangiopericytomas were also relatively common.

The sites of origin of 59 of the 99 fibromas could be determined from the available data (Table 4). The skin, particularly the limbs, accounted for 33 (56%) of these 59 neoplasms, followed by the female reproductive system (32,2%). Thirteen (68,4%) of the fibromas in the female genital tract arose in the vagina either as single or multiple growths. Of the fibromas in the digestive tract, the majority occurred in the oral cavity.

The distribution of 59 fibrosarcomas is shown in Table 5. Thirty-one (52,5%) occurred on the skin, particularly on the head and tail, 17 (28,9%) in the digestive

tract and 7 (11,9%) in the bones, notably those of the skull (Table 5). The 8 fibrosarcomas in the oesophagus were all initiated by a *Spirocerca lupi* infestation.

TABLE 2 Occurrence of the more common canine neoplasms

Numeral	Type of tumour	Number	% out of total 3 388 tumours
1	Mastocytoma	432	12,7
2	Lymphosarcoma	295	8,7
3	Melanoma	209	6,2
4	Squamous cell carcinoma	208	6,1
5	Basal cell tumour	174	5,1
6	Haemangiosarcoma	147	4,3
7	Histiocytoma	135	4,0
8	Mixed mammary gland tumour	133	3,9
9	Perianal gland adenoma	121	3,6
10	Fibrosarcoma	100	3,0
11	Fibroma	99	2,9
12	Osteosarcoma	94	2,8
13	Sertoli cell tumour	77	2,3
14	Lipoma	72	2,1
15	Mammary gland carcinoma	70	2,0
16	Transmissible venereal tumour	64	1,8
17	Haemangioma	63	1,8
18	Haemangiopericytoma	59	1,7
19	Mammary adenoma	57	1,7
20	Squamous papilloma	53	1,5
21	Seminoma	52	1,5
22	Thyroid carcinoma	35	1,0
23	Neurofibroma	30	0,8
Total		2 779	81,5

Five myxomas were recorded, 3 of which occurred in the skin, 1 on the scrotum and 1 on the vulva. The site of origin of 2 of the 3 myxosarcomas could not be determined, whilst the third arose in the oesophagus (Table 3).

Out of a total of 72 lipomas 69 (95,8%) occurred in the subcutis at various sites (Table 6), while 2 were perivaginal. Eight liposarcomas were also encountered, all in the subcutis (Table 3).

The smooth muscle tumours numbered 11 in all. Five (45,5%) of these occurred in the female genital tract and 4 (36,5%) in the digestive tract, whilst 1 (9%) involved the urinary bladder (Table 7).

There were only 4 tumours arising from striated muscle (Table 3). The site of origin of the solitary rhabdomyoma could not be determined. One of the 3 rhabdomyosarcomas arose in the heart and a second involved the ocular muscles (Tables 3 & 25).

TABLE 3 Neoplasms of the mesenchymal tissues

Tissue type	Type of neoplasm	Number	Percentage	% per tissue
Fibrous tissue	Fibroma	99	8,7	18,1
	Fibrosarcoma	100	8,8	
	Myxoma	5	0,4	
	Myxosarcoma	3	0,2	
Adipose tissue	Lipoma	72	6,3	7,0
	Liposarcoma	8	0,7	
Muscle tissue	Leiomyoma	8	0,7	1,2
	Leiomyosarcoma	3	0,2	
	Rhabdomyoma	1	0,1	
	Rhabdomyosarcoma	3	0,2	
Blood and lymph vessels	Haemangioma	63	5,5	24,0
	Haemangiosarcoma	147	12,9	
	Haemangiopericytoma	59	5,2	
	Lymphangioma	2	0,2	
	Lymphangiosarcoma	2	0,2	
Special tumours	Histiocytoma	135	11,8	49,7
	Mastocytoma	432	37,9	
Total		1 142	100	100

TABLE 4 Sites of origin of 59 fibromas

Tissue type	Specific site	Number	Total per tissue	% per tissue
Skin	Head	3	33	56,0
	Ear	1		
	Abdomen	3		
	Limbs	5		
	Not specified	21		
Female genital tract	Vulva	2	19	32,2
	Vagina	13		
	Cervix	2		
	Uterus	1		
	Ovary	1		
Digestive tract	Oral cavity	3	4	6,7
	Caecum	1		
Male genital tract	Prepuce	1	1	1,7
Skeletal system	—	1	1	1,7
Eye	Eyelid	1	1	1,7

TABLE 5 Sites of origin of 59 fibrosarcomas

Tissue type	Specific site	Number	Total per tissue	% per tissue
Skin	Head	2	31	52,5
	Neck	1		
	Abdomen	1		
	Tail	4		
	Not specified	23		
	Digestive tract	Oral cavity		
Oesophagus	8			
Skeletal system	Skull	3	7	11,9
	Rib	1		
	Humerus	1		
	Femur	1		
	Not specified	1		
Mammary gland	—	3	3	5,1
Liver	—	1	1	1,6

TABLE 6 Sites of origin of 72 lipomas

Tissue type	Specific site	Number	Total per tissue	% per tissue
Skin	Chest/abdomen	5	69	95,8
	Neck	1		
	Limbs	6		
	Not specified	57		
Retroperitoneal cavity	Perivaginal	2	2	2,8
Abdominal cavity	Mesentery	1	1	1,4

TABLE 7 Sites of origin of the smooth muscle tumours

Tissue type	Specific site	Number		Total per tissue	% per tissue
		Leiomyoma	Leiomyosarcoma		
Female reproductive tract	Uterus	2	—	5	45,5
	Cervix	1	—		
	Vagina	1	1		
Digestive tract	Oesophagus	1	1	4	36,5
	Intestine	1	1		
Urinary bladder		1	—	1	9,0
Undetermined		1	—	1	9,0
Total		8	3	11	100

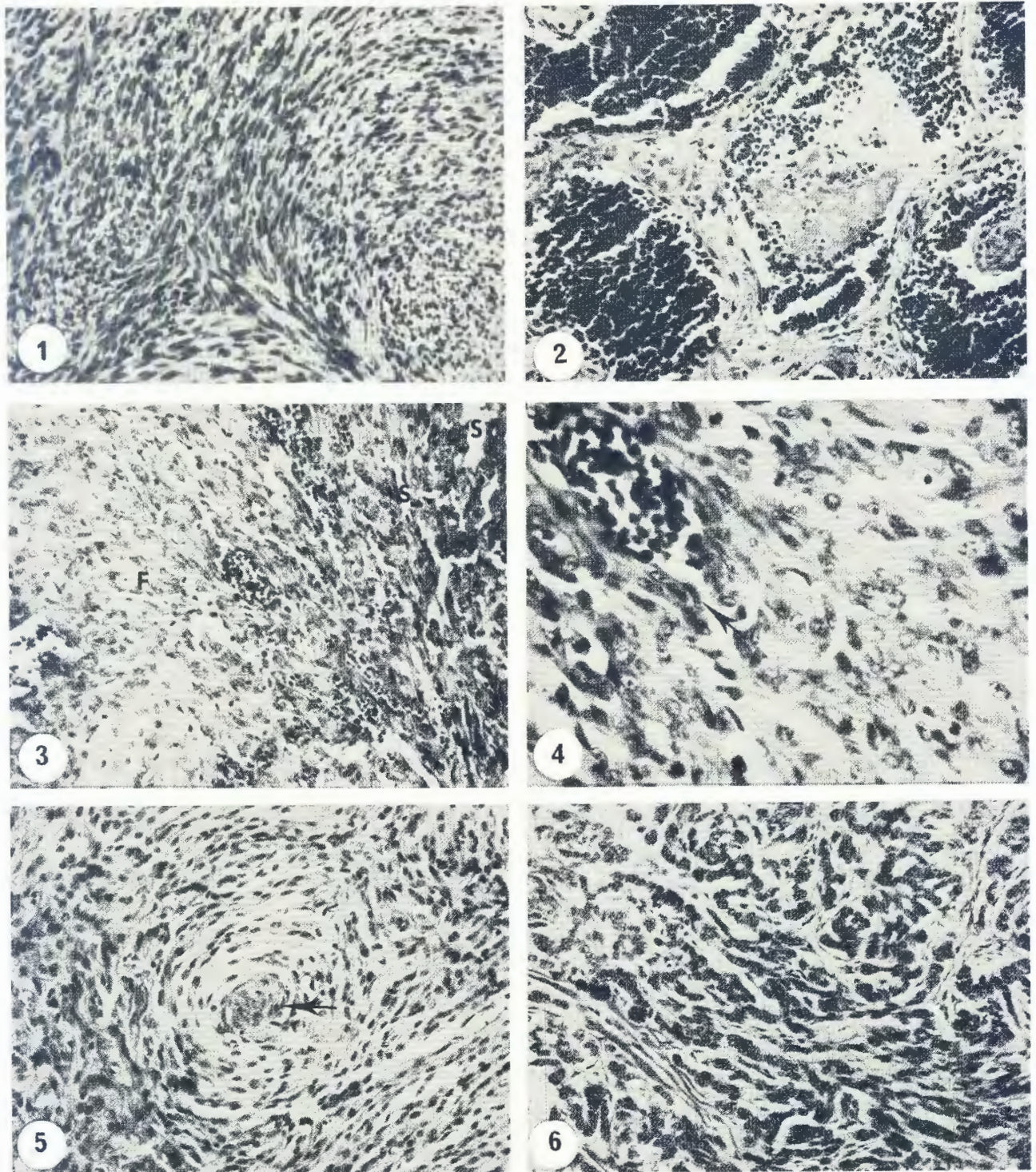


FIG. 1. Fibrosarcoma: Spindle-shaped cells arranged in an interwoven pattern: HE \times 200
FIG. 2. Haemangioma: Cavernous blood vessels filled with red blood cells and lined by flat endothelial cells: HE \times 200
FIG. 3. Haemangiosarcoma: Note fibrosarcomatous area (F) and slit-like vascular spaces (S): HE \times 200
FIG. 4. Haemangiosarcoma: Plump spindle-shaped cells arranged around vascular spaces (arrow) or slits: HE \times 500
FIG. 5. Haemangiopericytoma: Cells arranged in a whorled pattern forming a so-called fingerprint (arrow): HE \times 200
FIG. 6. Basal cell tumour: Cells arranged in garland pattern: HE \times 200

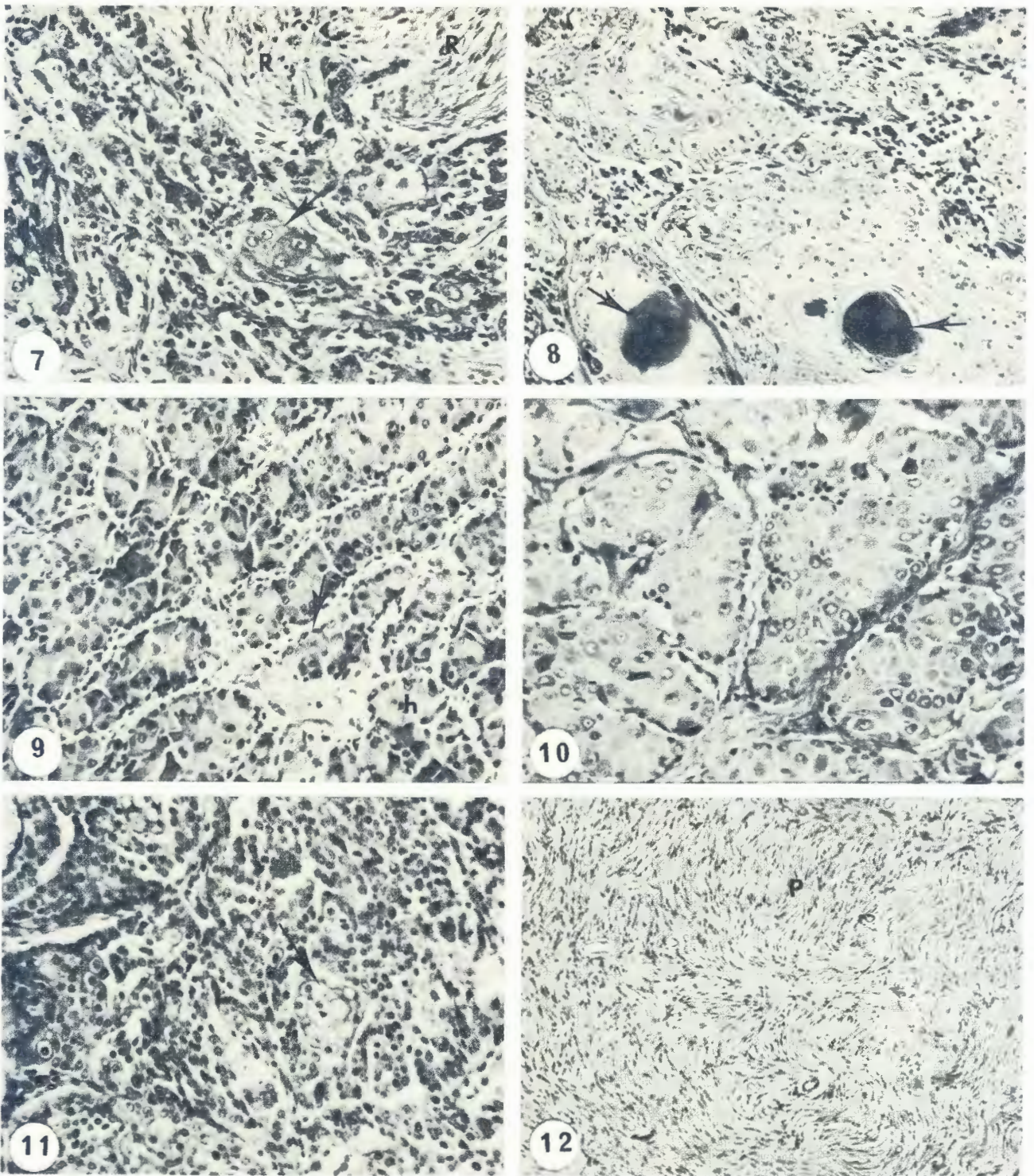


FIG. 7. Squamous cell carcinoma, invasive, anaplastic and inciting a scirrhous reaction (R). Note typical squamous cells (arrows): HE \times 200
 FIG. 8. Squamous cell carcinoma (well differentiated) with typical keratin pearls (arrows): HE \times 200
 FIG. 9. Perianal gland adenoma: Packet-like glandular arrangement of cells. Note dark staining reserve cells at edges (arrow) and typical "hepatoid" cells with vesicular nuclei and abundant cytoplasm in the centre (h): HE \times 200
 FIG. 10. Perianal gland adenoma: HE \times 500
 FIG. 11. Sebaceous gland adenocarcinoma composed predominantly of small round anaplastic, undifferentiated cells. Note group of differentiated sebaceous cells (arrow): HE \times 200
 FIG. 12. Neurofibroma: Note palisade arrangement of cells (P): HE \times 75

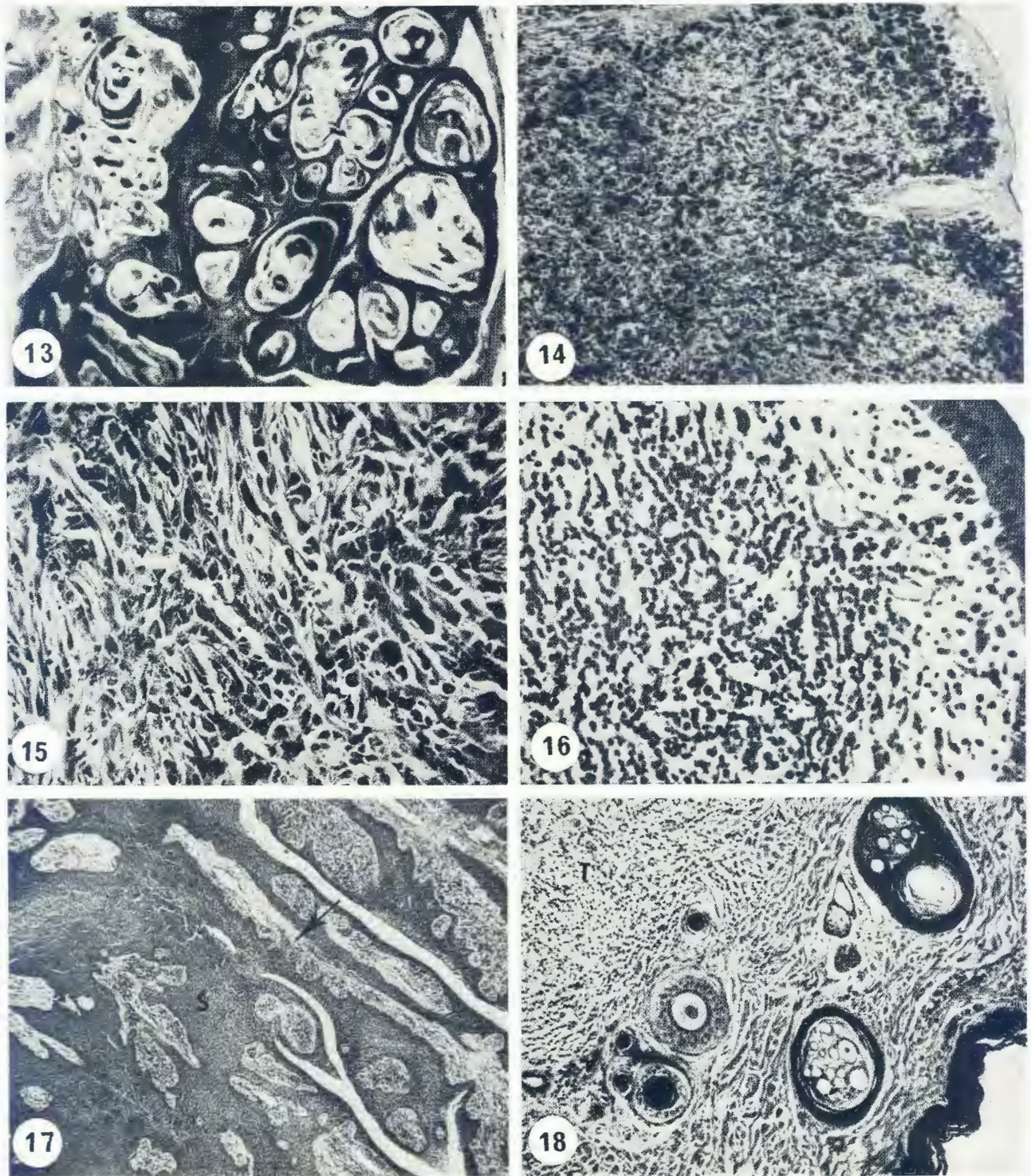


FIG. 13. Trichoepithelioma. Follicular structures filled with dark-staining keratin debris: HE \times 75

FIG. 14. Malignant dermal melanoma: Melanin-laden cells extending right up to epidermum: HE \times 75

FIG. 15. Malignant melanoma (fibromatous type): Spindle-shaped neoplastic cells laden with melanin pigment: HE \times 200

FIG. 16. Histiocytoma: Round tumour cells extending right up to the epidermum: HE \times 200

FIG. 17. Squamous papilloma: Broad sheets of squamous epithelium (s) surrounding narrow central fibrous cores (arrow): HE \times 75

FIG. 18. Mastocytoma: Tumour cells (T) which do not extend right up to the epidermum: HE \times 75

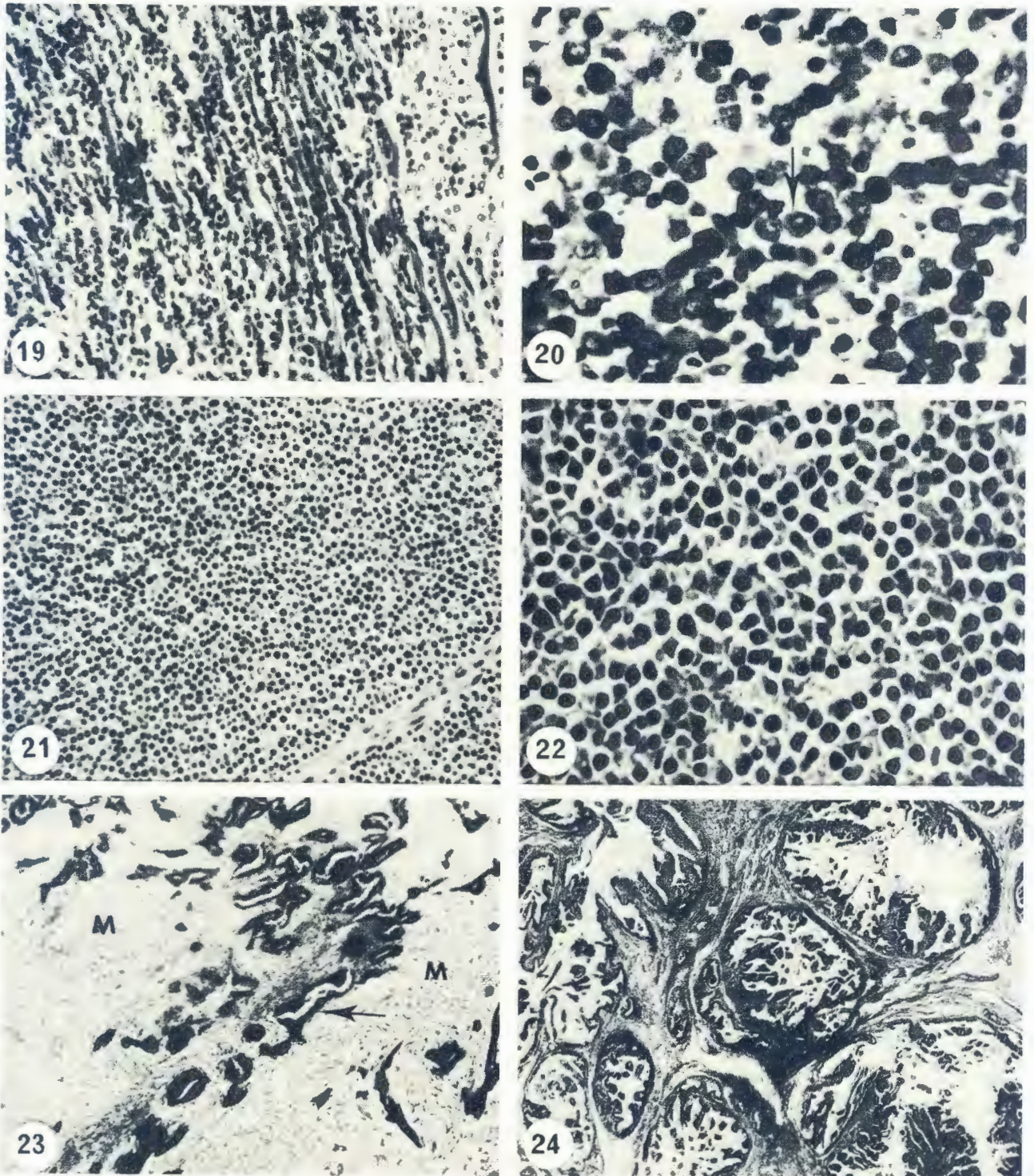


FIG. 19. Mastocytoma: Neoplastic cells arranged in rows between existing collagen fibres: HE \times 200

FIG. 20. Mastocytoma: Note central nuclei and dark-staining granules in cytoplasm (arrow): Toluidine blue \times 500

FIG. 21. Lymphosarcoma: Cells arranged in broad sheets completely obscuring architecture of the lymph node: HE \times 200

FIG. 22. Lymphosarcoma showing details of tumour cells (lymphoblastic type): HE \times 500

FIG. 23. Benign mixed mammary gland tumour: Note tubular epithelial component (arrow) embedded within myxomatous tissue of myo-epithelial origin (M): HE \times 75

FIG. 24. Mammary carcinoma (papillary type): HE \times 75

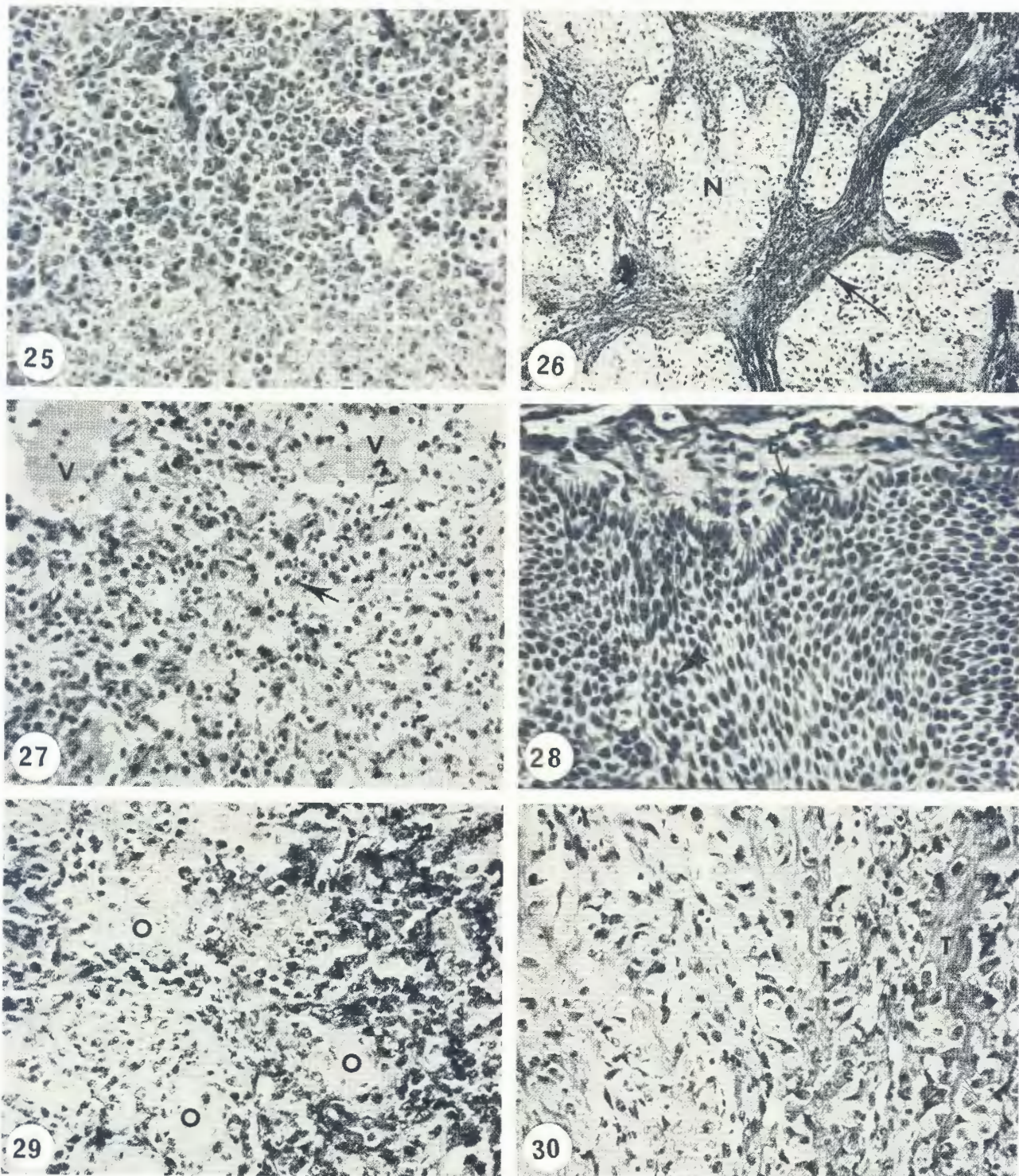


FIG. 25. Seminoma: Neoplastic cells (with vesicular nuclei) arranged in sheets: HE \times 200

FIG. 26. Sertoli cell tumour: Elongated neoplastic cells (N) arranged within tubules. Thick bands of fibrous tissue (arrow) surround the tubules: HE \times 75

FIG. 27. Leydig cell tumour: Note vacuolar cytoplasm (arrow) and vascular spaces (V): HE \times 200

FIG. 28. Adamantinoma: Elongated odontoblasts perpendicularly arranged (E) to cells in centre which are loosely arranged. Some of the latter cells have a stellate shape (arrowhead): HE \times 200

FIG. 29. Osteosarcoma: Note plump spindle-shaped cells surrounding areas of irregular osteoid deposition (O): HE \times 200

FIG. 30. Osteosarcoma: Groups of plump spindle-shaped osteoblastic tumour cells arranged around osteoid trabeculae (T): HE \times 200

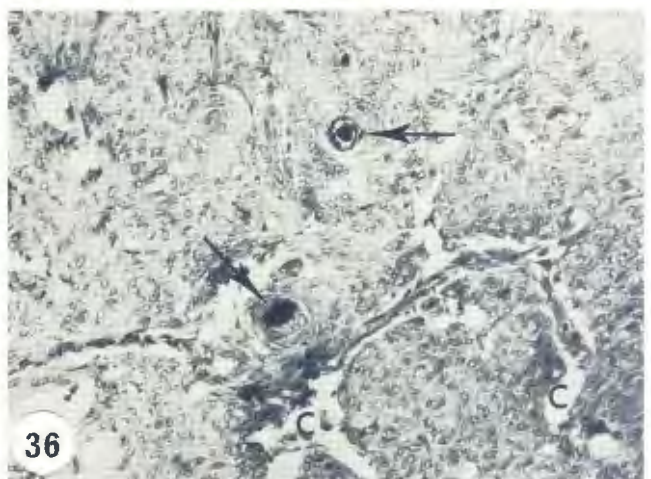
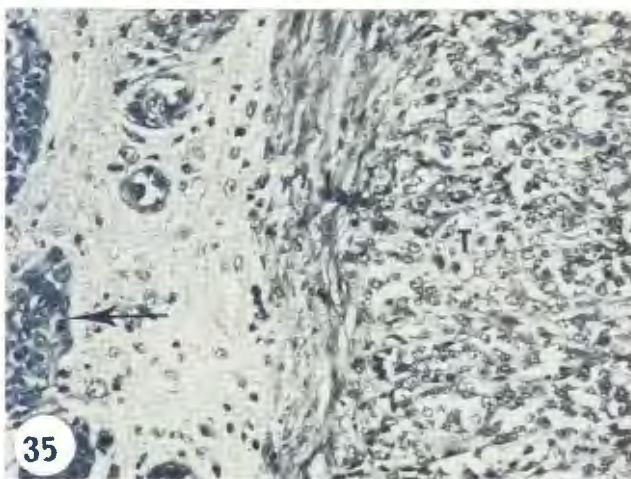
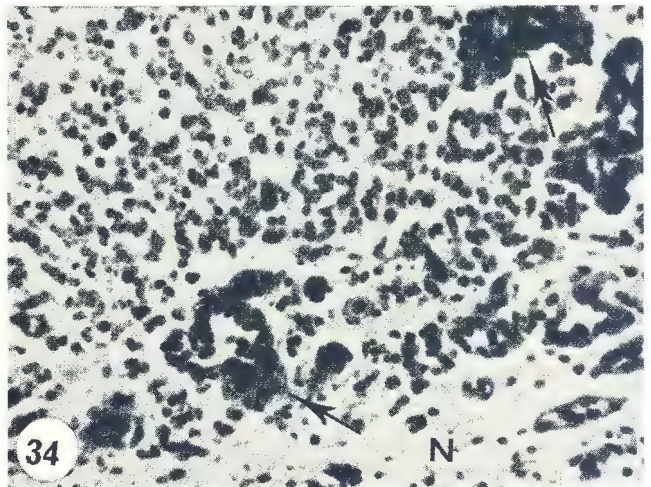
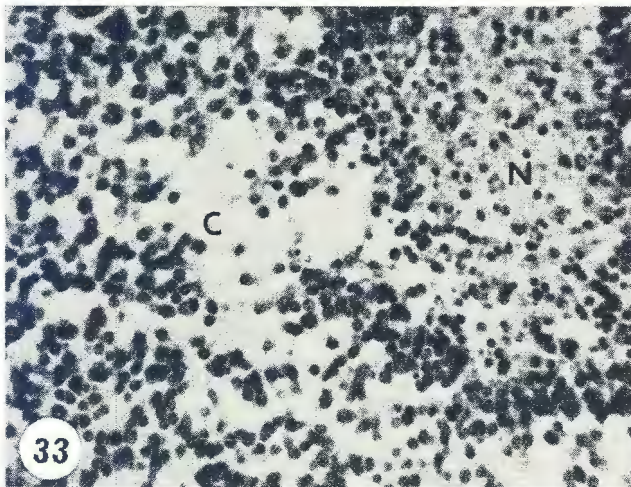
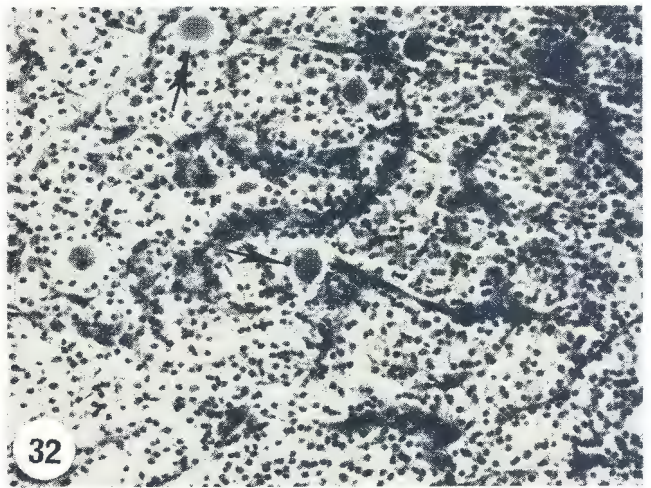
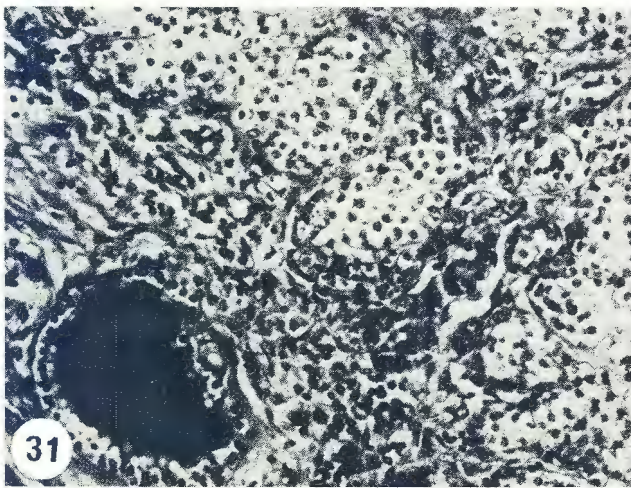


FIG. 31. Thyroid carcinoma (solid type): Note pre-existing thyroid follicle in lower left-hand corner: HE \times 200

FIG. 32. Thyroid carcinoma (solid/follicular type): Colloid can be seen in centre of follicular structures (arrows): HE \times 200

FIG. 33. Glioblastoma showing a cystic space (C) and a necrotic area (N): HE \times 200

FIG. 34. Glioblastoma: Note perivascular arrangement of neoplastic cells (arrow) and invasion of tumour into neural tissue (N): HE \times 200

FIG. 35. Astrocytoma: Note perivascular glomerular-like arrangement of neoplastic cells (arrow). The tumour cells (T) are loosely arranged and have vesicular nuclei: HE \times 200

FIG. 36. Meningioma: Cells arranged in whorls, the centres of some being calcified (arrows). Note also cleft-like spaces (C): HE \times 200

Haemangiosarcomas, the most frequently encountered vascular tumours, accounted for 147 (55%) of the 269 blood vessel tumours, followed by 63 haemangiomas (23%) and lastly by 59 haemangiopericytomas (22%) (Table 3). The distribution of 65 haemangiosarcomas is shown in Table 8. Most of the haemangiosarcomas (66,4%) involved the skin. The digestive tract and male genital tracts accounted for relatively high proportions of these tumours (Table 8). The site of origin of 54 haemangiomas could be determined, 96% of which involved the skin. Other sites of origin were the spleen and scrotum (Table 9). The sites of origin of 16 of the 59 haemangiopericytomas, 13 (81%) of which occurred on the limbs, are shown in Table 10. There were only 4 lymph vessel tumours, 2 lymphangiomas and 2 lymphangiosarcomas, all of which occurred in the skin (Table 3).

TABLE 8 Distribution of 65 haemangiosarcomas

Tissue type	Specific site	Number	Total per tissue	% per tissue
Skin	Head	1	43	66,4
	Chest	1		
	Abdomen	2		
	Multiple	1		
	Limbs	3		
	Not specified	35		
Digestive tract	Oral cavity	1	6	9,2
	Tongue	3		
	Intestine	1		
	Omentum	1		
Male reproductive tract	Scrotum	3	6	9,2
	Penis	2		
	Prepuce	1		
Heart	Right atrium	3	3	4,6
Liver	—	3	3	4,6
Skeletal system	Mandible	1	2	3,0
	Ischium	1		
Eye	Sclera	1	1	1,5
Respiratory system	Frontal sinus	1	1	1,5

TABLE 9 Distribution of 54 haemangiomas

Tissue type	Specific site	Number	Total per tissue	% per tissue
Skin	Thorax	1	52	96
	Abdomen	3		
	Limbs	2		
	Not specified	46		
Lymphoid tissue	Spleen	1	1	2
Male reproductive tract	Scrotum	1	1	2

TABLE 10 Sites of origin of 16 haemangiopericytomas

Site	Number	% of total
Head (ear)	1	6,5
Abdomen/perineum	2	12,5
Forelimbs	7	44,0
Hindlimbs	6	37,0

Histiocytomas accounted for 135 (11,8%) of the mesenchymal tissue tumours (Table 3). The distribution of 25 of these neoplasms, all of which occurred on the head or limbs, is shown in Table 11. The age of 43 of the 135 dogs with histiocytomas could be determined. Nineteen (44%) of these were between 4-12 months, 15 (35%) between 1-3 years, 6 (14%) between 4-6 years and only 3 (7%) were older than 6 years.

TABLE 11 Sites of origin on skin of 25 histiocytomas

Region	Specific site	Number	Total per region	% per region
Head	Ear	5	11	44
	Lip	5		
	Eyelid	1		
Limbs	Shoulder	1	14	56
	Elbow	1		
	Carpus/metacarpus	2		
	Paw	5		
	Not specified	5		

Mastocytomas made up 432 (37,9%) of the mesenchymal tumours (Table 3). They were also the single most frequently encountered type of tumour, accounting for 12,7% of the total 3 388 neoplasms (Table 2). The sites of origin for 86 of these mastocytomas are shown in Table 12. The majority (40,8%) occurred on the scrotum. The head and limbs were also relatively common sites, whilst 9 (10,5%) arose at multiple sites on the skin.

TABLE 12 Distribution of 86 mastocytomas

Site of origin	Number	Percentage
Head	11	12,8
Neck	1	1,2
Thorax	4	4,6
Abdomen/perineum	7	8,1
Limbs	11	12,7
Multiple sites on skin	9	10,5
Scrotum	35	40,8
Prepuce	2	2,3
Metastatic sites	6	7,0

The skin and adnexa, the second most frequently neoplastic type of tissue, accounted for 703 (20,8%) of the total tumours (Table 1). Of these basal cell tumours were the commonest type of tumour (24,2%), followed by squamous cell carcinomas (21%), perianal gland adenomas (17,2%) and melanomas (14,7%) (Table 13).

TABLE 13 Neoplasms of the skin and adnexa

Tissue type	Type of tumour	Number	Number per tissue type	% per tissue type
Surface epithelium	Basal cell tumours	170	346	49,2
	Squamous cell carcinoma	148		
	Squamous papilloma	26		
	Intracutaneous cornifying epithelioma	2		
	Tumour-like hyperplasia of sebaceous glands and sebaceous gland adenomas	55		
Sebaceous and modified sebaceous glands	Sebaceous gland carcinoma	13	202	28,7
	Perianal gland adenoma	121		
	Perianal gland adenocarcinoma	13		
	Melanoma	103		
Sweat and modified sweat glands	Sweat gland adenoma	9	33	4,7
	Sweat gland adenocarcinoma	12		
	Ceruminous gland adenoma	12		
	Trichoepithelioma	18		
Hair follicles	Necrotizing epithelioma	1	19	2,7
Total			703	100

The sites of origin of the basal cell tumours, 98% of which arose on the skin and 2% on the eyelids, are shown in Table 14. Twenty (59%) of the 34 tumours for which the exact site of origin on the skin could be determined arose on the head, 8 (24%) on the limbs, whilst the remaining 6 (17%) occurred at various sites. Basal cell tumours were the fifth most commonly encountered type of neoplasm, accounting for 5,1% of the total (Table 2).

There were a total of 208 squamous cell carcinomas, 71,2% of which arose on the skin, 12% in the male genital tract, 10% in the digestive tract, 6,3% in the eye and 0,5% in the vagina (Table 15). Squamous cell carcinomas were the fourth commonest type of tumour, constituting 6,1% of the total neoplasms (Table 2). The cutaneous squamous cell carcinomas arose at various sites on the skin (Table 15). The majority (72%) of the squamous cell carcinomas in the male reproductive system arose on the prepuce and the remaining 28% on the scrotum. Eight (38%) of the 21 tumours in the digestive tract occurred in the tonsils, 4 (19%) on the tongue and 4 (19%) on the lips or gums. Seven (77,8%) of the 9 squamous cell carcinomas of the eye, for which the site of

origin could be determined, occurred on the eyelid, 1 on the conjunctiva and 1 on the nictitating membrane. Only 1 squamous cell carcinoma was reported in the female genital tract (Table 15).

TABLE 14 The distribution of the basal cell tumours

Tissue type	Specific site	Number	Total per tissue type	% per tissue type
Skin	Not specified	136	170	98
	Head/face	15		
	Ears	5		
	Neck	2		
	Abdomen	3		
	Prepuce	1		
	Limbs	8		
Eye	Eye	4	4	2
Total			174	100

TABLE 15 The distribution of the squamous cell carcinomas

Tissue type	Specific site	Number	Total per tissue type	% per tissue type
Skin	Head	7	148	71,2
	Neck	1		
	Body	18		
	Limbs	9		
	Not specified	113		
Male reproductive tract	Prepuce/penis	18	25	12,0
	Scrotum	7		
Digestive tract	Tonsil	8	21	10,0
	Tongue	4		
	Lips/gums	4		
	Hard palate	1		
	Not specified	4		
Eye	Eye	7	13	6,3
	Conjunctiva	1		
	Nictitating membrane	1		
	Not specified	4		
	Vagina	1	1	0,5
Total			208	100

Squamous papillomas numbered 53 in all. The sites of origin for 44 of these were determined: 26 (60%) on the skin (Table 13), 16 (36%) in the oral cavity (Table 21), 1 (2%) in the trachea (Table 26) and 1 (2%) in the urinary bladder.

Perianal gland adenomas made up 121 (17,2%) of the skin tumours (Table 13). The distribution of 65 of these tumours was as follows: 56 (86%) in the perianal region; 5 (8%) on the tail; and 4 (6%) on the prepuce. The sites

of origin of 7 of the perianal gland adenocarcinomas could be determined, 6 (85%) of which occurred in the perianal region and 1 (15%) on the tail. Perianal gland adenomas were the ninth most frequently encountered type of neoplasm, accounting for 3,6% of the total tumours (Table 2).

Melanomas occurred in various tissues of the body, 62% of 166 tumours arising in the skin, 20% in the oral cavity, 14% in the eye and 4% in the male reproductive tract (Table 16). The dermal melanomas occurred at various sites on the skin. The oral melanomas also had a varied distribution. The majority of melanomas of the eye involved the eyelid and those of the male genital tract, the scrotum. The histological designation for 64 of the 209 tumours could not be ascertained. One hundred and eighteen (81%) of the remaining 145 were regarded as malignant, and 27 (19%) as benign. The majority of benign melanomas occurred on the skin or eyelid, whilst 2 arose on the scrotum and penis. All the oral tumours and 50 (80%) of 62 dermal melanomas were malignant (Table 16). The 209 melanomas accounted for 6,2% of all the tumours and were the third most common tumours in this survey (Table 2).

The other skin tumours included intracutaneous cornifying epitheliomas, trichoepitheliomas and necrotizing trichoepitheliomas, tumour-like hyperplastic conditions of sebaceous glands and sebaceous gland adenomas, sebaceous gland carcinomas, sweat gland adenomas and adenocarcinomas and ceruminous gland adenomas of the ears. The sebaceous gland adenomas and tumour-like hyperplastic conditions of sebaceous glands have been regarded as a single entity, as it was not always clear from the available data which of the 2 types was involved (Table 13).

The female reproductive system was the third most frequently neoplastic type of tissue (Table 1). The different types of tumours occurring in this system are shown in Table 17. The mammary gland accounted for 260

(80,7%) of the neoplasms of this system. One hundred and thirty-three (51%) of the mammary tumours were mixed mammary tumours, 70 (27%) were carcinomas and 57 (22%) were adenomas. Of the 133 mixed mammary tumours, the histological designation of 38 could not be determined. Sixty (63%) of the remaining 95 were benign in nature and the remaining 35 (37%) malignant.

The vagina and ovary were, respectively, the second and third most commonly diagnosed neoplastic organs of the female genital tract (Table 17).

Transmissible venereal tumours (TVT) arising in the vulva and vagina were the fourth commonest type of tumour of the female genital tract and accounted for 15 (4,7%) of the total 322 neoplasms (Table 17). There was a total of 64 TVT which were the sixteenth most frequent type of tumour (Table 2). The sites of origin of 38 TVT could be determined. Fifteen (39%) of them occurred in the vagina and vulva, 14 (37%) on the prepuce, penis or scrotum, 8 (21%) on the skin and 1 (3%) in the mouth (Table 18).

Fibromas were a relatively common tumour of the female genital tract, accounting for 19 (6%) of the 322 tumours. Thirteen (68%) of these occurred in the vagina (Tables 4 & 17). The granulosa cell tumour was the most frequent ovarian neoplasm. Uterine carcinomas accounted for only 4 (1,2%) of the 322 female genital tract neoplasms (Table 17).

The lymphohaemopoietic tissue was the fourth most frequently neoplastic type of tissue (Table 1), whilst lymphosarcomas were the second most common type of tumour (Table 2). The anatomical forms or organs involved in 88 cases of lymphosarcoma are shown in Table 19. The most common forms were the multicentric (55,6%) and alimentary forms (13,6%). The skin, thymus and tonsils also had a relatively high incidence. There were 4 cases of myeloid leukaemia, which constituted only 1,3% of the lymphohaemopoietic tumours, and 3 (1%) myelomas.

TABLE 16 Sites of origin of 166 melanomas

Tissue type	Specific site	Histological designation			Total per tissue type	% per tissue type
		Malignant	Benign	Not stated		
Skin	Head	1	1	—	103	62
	Ear	2	1	—		
	Thorax/abdomen	3	1	1		
	Limbs (not specified)	3	1	—		
	Paws	6	2	2		
	Not specified	35	12	32		
Oral cavity	Tongue	3	—	—	33	20
	Tonsil	3	—	—		
	Hard palate	1	—	—		
	Not specified	20	—	6		
Eye	Eyelid	5	5	6	23	14
	Nictitating membrane	1	—	—		
	Sclera/choroid	1	—	—		
	Not specified	2	1	2		
Male reproductive tract	Scrotum	4	1	1	7	4
	Prepuce	—	1	—		

TABLE 17 The neoplasms of the female reproductive system

Organ	Type of tumour	Number	Total per organ	% per organ
Ovary	Granulosa cell tumour	13	18	5,5
	Adenoma	3		
	Adenocarcinoma	1		
	Fibroma	1		
Uterus	Adenocarcinoma	4	8	2,5
	Leiomyoma	3		
	Fibroma	1		
Cervix	Fibroma	2	3	1,0
	Leiomyoma	1		
Vagina	Fibroma	13	27	8,4
	Transmissible venereal tumour	11		
	Leiomyoma	1		
	Leiomyosarcoma	1		
	Squamous cell carcinoma	1		
Vulva	Transmissible venereal tumour	4	6	1,9
	Fibroma	2		
Mammary gland	Mixed mammary tumour	133	260	80,7
	Mammary carcinoma	70		
	Mammary adenoma	57		
Total			322	100

TABLE 18 The distribution of 38 transmissible venereal tumours

Tissue/body system	Specific site	Number	Total per tissue	% per tissue
Female reproductive system	Vagina	11	15	39
	Vulva	4		
Male reproductive system	Prepuce/penis	12	14	37
	Scrotum	2		
Skin	Various sites	8	8	21
Digestive tract	Mouth	1	1	3

The fifth most frequently neoplastic body system was the male genital tract (Table 1). The testes accounted for 63,5% of the 233 neoplasms, the scrotum for 18,9%, the penis and prepuce for 14,2% and the prostate for 3,4% (Table 20).

Sertoli cell tumours were the commonest testicular tumours, accounting for 77 (52%) of the 148 neoplasms, followed by seminomas (35%) and Leydig cell tumours (13%). All the seminomas and Leydig cell tumours occurred in descended testicles, while 9 (11,6%) of the Sertoli cell tumours involved retained testes.

Thirty-five (80%) of the 44 scrotal tumours were mastocytomas, 7 (16%) were squamous cell carcinomas and only 2 (4%) were TVT (Table 20).

TABLE 19 The anatomical form or organs involved in 88 cases of lymphosarcoma

Anatomical form/organ	Number	Percentage
Multicentric form	49	55,6
Alimentary form	Intestine	10
	Stomach	2
Skin	10	11,3
Thymus and thoracic lymph nodes	7	8,0
Tonsils	6	6,8
Lymphoid leukaemia	2	2,3
Spinal cord	1	1,2
Eye	1	1,2

TABLE 20 Neoplasms of the male reproductive system

Organ	Type of tumour	Number	Total per organ	% per organ
Testis	Sertoli cell tumour	77	148	63,5
	Seminoma	52		
	Leydig cell tumour	19		
Prostate	Adenocarcinoma	6	8	3,4
	Adenoma	2		
Penis/prepuce	Squamous cell carcinoma	18	33	14,2
	Transmissible venereal tumour	12		
	Mastocytoma	2		
	Fibroma	1		
Scrotum	Mastocytoma	35	44	18,9
	Squamous cell carcinoma	7		
	Transmissible venereal tumour	2		
Total			233	100

Squamous cell carcinomas accounted for 18 (54,5%) of the 33 penile/preputial tumours and TVT for 12 (36,4%). Mastocytomas made up only 6% of the tumours at the latter site. There was also 1 fibroma at this site (Table 20).

Only 8 (3,4%) of the male genital tract tumours arose in the prostate, 6 of these being adenocarcinomas and 2 adenomas (Table 20).

The digestive tract was the sixth most commonly neoplastic body system with 184 (5,4%) of the total 3 388 tumours (Table 1). The oral cavity accounted for 127 (59,6%) of the 213 digestive tract tumours, 26 (12,2%) of which arose in the oesophagus, 24 (11,2%) in the intestines and 22 (10,4%) were of odontogenic origin. The rest of the neoplasms were encountered in the salivary and pancreatic glands and in the mesothelium (Table 21).

Eplulides of the inflammatory type were the most frequently encountered type of tumour of the digestive tract with 48 (22,5%) of the total, followed by melanomas

(15,4%) and squamous cell carcinomas (10%). Inflammatory epulides made up 48 (32,2%) of the 149 oral cavity neoplasms, whilst the relatively common adamantinomas accounted for 15 (10%). All the melanomas arose in the oral cavity and constituted 33 (22%) of the neoplasms of this region. Squamous cell carcinomas accounted for 21 (14,3%) of the oral cavity tumours, the majority of which arose on the tongue. The squamous papillomas of the digestive tract made up 16 (6,5%) of the oral cavity neoplasms (Table 21).

All the 26 oesophageal tumours encountered were due to a *Spirocerca lupi* infestation. Seventeen (65,4%) were osteosarcomas, 8 (30,8%) fibrosarcomas and one (3,8%) was a chondrosarcoma (Table 21). The majority of osteosarcomas and fibrosarcomas, however, arose respectively in the skeletal system (Table 22) and the skin (Table 5).

Twenty-four (11,2%) of the digestive tract tumours involved the intestines, 12 (50%) of which were adenocarcinomas, 10 (42%) lymphosarcomas and the remainder, adenomas of the rectum (Table 21).

The exocrine pancreas accounted for 2,8% of the 213 digestive tract neoplasms, the salivary glands for 2,3%, whilst only 2 gastric tumours and 1 mesothelioma were encountered (Table 21).

TABLE 21 Tumours of the digestive tract

Organ/Region	Type of tumour	Number	Number per organ/region	% per organ/region
Odontogenic neoplasms	Adamantinoma	15	22	10,4
	Fibromatous epulis (periodontal origin)	5		
	Type undetermined	2		
Oral cavity	Epulis	48	127	59,6
	Melanoma	33		
	Squamous cell carcinoma	21		
	Squamous papilloma	16		
	Fibrosarcoma	9		
Salivary glands	Adenocarcinoma	3	5	2,3
	Adenoma	2		
Oesophagus	Osteosarcoma	17	26	12,2
	Fibrosarcoma	8		
	Chondrosarcoma	1		
Stomach	Carcinoma	1	2	1,0
	Lymphosarcoma	1		
Intestine	Adenocarcinoma	12	24	11,2
	Lymphosarcoma	10		
	Adenoma (rectum)	2		
Exocrine pancreas	Pancreatic adenocarcinoma	6	6	2,8
Mesothelium	Mesothelioma	1	1	0,5
Total			213	100

There was a total of 99 skeletal system tumours, the distribution of which is shown in Table 22. Seventy-seven (77,8%) were osteosarcomas, 4% osteomas, 4% osteoclastomas, 7,1% chondrosarcomas and 7,1% chondromas (Table 22). The exact site of origin of only 15 of the osteosarcomas could be ascertained, 5 (33,4%) of which arose in the humerus 33,4% in the spinal column, 13,3% in the mandible and ribs, respectively, and 6,6% in the femur. Other primary bone tumours included fibromas, fibrosarcomas and haemangiosarcomas (Tables 4, 5 & 8).

TABLE 22 The distribution of 99 skeletal tumours

Type of tumour	Site	Number	Total for each tumour	% for each tumour
Osteosarcoma	Not determined	62	77	77,8
	Humerus	5		
	Spinal column	5		
	Mandible	2		
	Rib	2		
	Femur	1		
Osteoma	Undetermined	3	4	4,0
	Mandible	1		
Osteoclastoma	Undetermined	2	4	4,0
	Radius/ulna	1		
	Tibia	1		
Chondrosarcoma	Undetermined	5	7	7,1
	Scapula	1		
	Rib	1		
Chondroma	Undetermined	6	7	7,1
	Rib	1		

TABLE 23 Tumours of the endocrine system

Gland/tissue	Type of tumour	Number	Number per gland/tissue	% per gland/tissue
Thyroid	Carcinoma	35	45	68,2
	Adenoma	9		
	Malignant mixed thyroid tumour	1		
Adrenal medulla and paraganglia	Chemodectoma	7	8	12,2
	Phaeochromocytoma	1		
Adrenal cortex	Adrenocortical adenoma	5	7	10,6
	Adrenocortical carcinoma	2		
Endocrine pancreas	Pancreatic cell carcinoma	3	3	4,5
Pituitary gland	Pituitary adenoma	2	3	4,5
	Craniopharyngioma	1		
Total			66	100

The endocrine tumours numbered 66 (Table 1), 45 (68,2%) of which arose in the thyroid gland, 12,2% in the adrenal medulla and paraganglia, 10,6% in the adrenal cortex, 4,5% in the pituitary and 4,5% from the cells of the pancreas (Table 23). Thyroid carcinomas were the twenty-second most frequently encountered type of tumour (Table 2) and constituted 53% of all the endocrine tumours (Table 23). Thyroid gland adenomas were the second most common endocrine tumours, constituting 13,6% of the total, adrenocortical adenomas third with 7,6%, and pancreatic β cell carcinomas fourth with 4,5% (Table 23).

There were 58 tumours arising in the nervous system (Table 1). Forty-three (74%) of these originated in the peripheral nerves and only 15 (26%) in the central nervous system (CNS) (Table 24). Twenty-nine of the neurofibromas occurred in the skin and 1 on the eyelid. Of the 4 on the skin for which the site of origin could be determined, 3 involved the hindlimbs and the fourth occurred on a forelimb. Six of the 11 neurofibrosarcomas arose on the skin at various sites, including the neck, shoulder, chest and scrotum, 1 occurred on the eyelid and another originated in the diaphragm and spread to the liver, heart and omentum.

Meningiomas accounted for 12% of the 58 nervous system tumours. Astrocytomas or glioblastomas were the most common glial tumours, with 5 (56%) of the 9 glial tumours (Table 24).

TABLE 24 Neoplasms of the nervous system

Tissue type	Type of tumour	Number	Number per tissue type	% per tissue type
Peripheral nerves	Neurofibroma	30	43	74
	Neurofibrosarcoma	11		
	Schwannoma	2		
Glial tumours	Astrocytoma/glioblastoma	5	8	14
	Oligoglioma	2		
	Medulloblastoma	1		
Meninges	Meningioma	7	7	12
Total			58	100

The eye and adnexa were the tenth most frequently encountered neoplastic types of tissue (Table 1). Of the different types of ocular tumours (Table 25), 45% arose from squamous epithelium and adnexa and 45% from melanogenic tissue. The remaining 5 tumours were of mesenchymal, nervous or lymphoid tissue origin (Table 25).

The eye accounted for 14% of the total melanomas, the majority of which arose on the eyelid (Table 16). The ocular tumours arising from squamous epithelium and adnexa included a variety of different types, 10 (41,6%) of which were squamous cell carcinomas (Table 25). The majority of the latter neoplasms occurred on the eyelid (Table 15).

The respiratory tract made up 43 (1,3%) of the total 3 388 neoplasms (Table 1 & 26). Sixty-five percent arose in the lungs, 30% in the nasal cavity and 5% in the sinuses and respiratory passages (Table 26). Pulmonary adenocarcinomas were the most commonly encountered

respiratory tumours, with 20 (46,5%) of the 43 tumours, followed by nasal carcinomas, with 23,2%. Pulmonary adenocarcinomas accounted for 72% of the pulmonary tumours, epidermoid carcinomas for 14%, combined epidermoid/adenocarcinomas for 7%, whilst another 7% were adenocarcinomas which arose from the bronchial mucous glands (Table 26).

TABLE 25 Tumour of the eye and adnexa

Tissue type	Type of tumour	Number	Number per tissue type	% per tissue type
Squamous epithelium and adnexa	Squamous cell carcinoma	10	24	45
	Squamous papilloma	4		
	Basal cell tumour	4		
	Sebaceous/meibomian gland adenoma	4		
	Sebaceous/meibomian gland adenocarcinoma	2		
Melanogenic tissue	Melanoma	23	23	43
Mesenchymal tissue	Fibroma (eyelid)	1	2	4
	Rhabdomyosarcoma	1		
Peripheral nerves	Neurofibroma	1	2	4
	Neurofibrosarcoma	1		
Iridociliary epithelium	Ciliary body adenoma	1	1	2
Lymphoid tissue	Lymphosarcoma	1	1	2
Total			53	100

TABLE 26 Neoplasms of the respiratory tract

Tissue type	Type of tumour	Number	Number per tissue type	% per tissue type
Nasal cavity	Carcinoma	10	13	30
	Adenoma	3		
Sinuses	Sinus carcinoma	1	1	2,5
Respiratory passages	Papilloma (trachea)	1	1	2,5
Lung	Pulmonary adenocarcinoma	20	28	65,0
	Epidermoid carcinoma	4		
	Combined epidermoid/adenocarcinoma	2		
	Adenocarcinoma arising from bronchial mucous glands	2		
Total			43	100

The liver and biliary tree accounted for only 33 (1,0%) of the total canine tumours in this survey (Table 1). They included 17 (52%) cholangiocarcinomas, 13 (39%)

hepatocellular carcinomas, 2 (6%) bile duct cystadenomas and 1 (3%) gall bladder adenocarcinoma.

There were only 25 tumours arising in the urinary tract (Table 1). These comprised 12 (48%) transitional cell carcinomas (6 of which arose from the renal pelvis and 6 from the urinary bladder mucosa), 6 (24%) renal adenomas, 3 (12%) embryonal nephromas and 1 (4%) papilloma which arose in the urinary bladder.

The 141 tumours of undetermined origin or for which the site of origin could not be determined included a miscellany of different types, namely, 43 melanomas, 34 squamous cell carcinomas, 9 papillomas and 5, 28 and 22 undifferentiated adenomas, carcinomas and sarcomas, respectively.

DISCUSSION

The 5 most commonly encountered neoplastic tissues included the mesenchymal tissues, skin, lymphoid tissue and the male and female genital tracts. De Kock (1962) reported similar findings. Carrara & Cremagnani (1964) on the other hand noted that the tissues most commonly involved were the liver and respiratory system. They did, however, also report high incidences for neoplasms of the lymphoid tissue and male and female genital tracts.

Mastocytomas, mammary gland tumours, perianal gland adenomas, squamous cell carcinomas, lymphosarcomas, melanomas, histiocytomas, lipomas and fibrosarcomas were amongst the more common canine neoplasms recorded in 2 surveys in the USA (Mulligan, 1949; Sastry & Tweihaus, 1964). In this survey the more common tumours in order of frequency were mastocytomas, lymphosarcomas, melanomas, squamous cell carcinomas, basal cell tumours, haemangiosarcomas and histiocytomas. Rahko (1968) recorded fibrosarcomas, squamous cell carcinomas, histiocytomas, fibromas, lipomas and haemangiomas as the most common types of tumours. He noted that Boxers were the breed with the most neoplasms, followed by Cocker Spaniels, Alsations, Collies and Dachshunds. In a study of an equal number of cases from Boxers and other breeds of dogs, Howard & Nielsen (1965) showed that Boxers had a significantly higher incidence of neoplasia, particularly mastocytomas, histiocytomas, endocrine tumours, haemangiomas and epulides.

Mesenchymal tissues accounted for 33,7% of the total tumours. The more frequently encountered neoplasms of mesenchymal tissue origin were mastocytomas (37,9%), followed by blood vessel tumours (23,6%), fibrous tissue tumours (17,5%) and histiocytomas (11,8%). Mulligan (1961 a) also recorded mastocytomas as the most common mesenchymal tumours. However, unlike the findings recorded in this survey, he reported the order of frequency after mastocytomas to be histiocytomas, blood vessel tumours, adipose tissue neoplasms and fibrous tissue tumours.

Mulligan (1949) reported that 24% of 264 mesenchymal tissue tumours arose from fibrous tissue, 19,7% from adipose tissue, 12% from smooth muscles and 11% from blood vessels, and that 29,5% were mastocytomas and 18% histiocytomas. In this survey there were similar findings in that 18,1% were of fibrous tissue origin, 7% of adipose tissue origin, 24% of blood vessel origin, whilst 37,9% were mastocytomas and 11,8% histiocytomas. Only 0,9%, however, were of smooth muscle origin.

Boston Terriers and Fox Terriers are more prone to develop fibromas. Fibromas are commonly located on the skin of the extremities, the oral cavity and vagina

(Mulligan, 1949; Mulligan, 1961 a). Fifty-six per cent of 59 fibromas in this survey involved the skin, especially the limbs, 22% the vagina and 5% the oral cavity.

The commonest sites for fibrosarcomas in the dog are reported to be the skin and oral and nasal cavities (Mulligan, 1961 a; Moulton, 1978). In this survey the most common sites for this tumour were the skin, the oral cavity, the oesophagus and the skeletal system.

The myxomas in this survey occurred in the subcutis of the scrotum and in the vulva, whilst one of the 3 myxosarcomas involved the oesophagus. Sastry & Tweihaus (1964) reported on 2 myxomas arising in the vagina. Moulton (1978) states that, like fibromas and fibrosarcomas, tumours of myxomatous origin can arise at any site where there is connective tissue. Mulligan (1949) noted that these tumours arose in the skin, especially in the axillary, inguinal, cervical, retroperitoneal and frontal regions.

Lipomas are common neoplasms of the dog (Mulligan, 1949; Sastry & Tweihaus, 1964; Gleiser, Jardine, Raulston & Gray, 1979). They are reported more commonly in German Shepherds, Collies, Scottish Terriers and Spaniels (Mulligan, 1949). Common sites include the subcutis of the abdomen, limbs and shoulders and, less commonly, the head, chest and perivaginal positions (Mulligan, 1949; Sastry & Tweihaus, 1964; Moulton, 1978). In this survey lipomas occurred primarily in the subcutis of the chest, abdomen or limbs, whilst approximately 3% arose perivaginally.

Liposarcomas are rare canine tumours which accounted for only 0,5% of 632 canine neoplasms in an Australian survey (Jabara, 1964). She concluded that in dogs there is no breed or sex predisposition nor any specific site predilection for these tumours. In man, the growth rate of liposarcoma varies from slow to rapid, but is more commonly slow (Jabara, 1964).

There were only 11 leiomyomas in this survey. They arose in the female genital tract, oesophagus, intestine and urinary bladder. Leiomyosarcomas were encountered in the vagina and digestive tract. Common sites for smooth muscle tumours are reported to be the gastrointestinal and urogenital tracts (Mulligan, 1949; Moulton, 1978).

Tumours originating from striated muscles made up only 0,1% of the total 3 388 neoplasms. The site of origin of the rhabdomyoma in this series could not be determined. Benign striated muscle tumours are less frequent than their malignant counterparts, and the majority have been reported to involve the heart as congenital tumours. Rhabdomyosarcomas on the other hand have been noted primarily in the muscles of the limbs and to a lesser extent the thorax, brisket and oral cavity (Moulton, 1978). In this series 1 rhabdomyosarcoma arose in the heart and 1 in the ocular muscles.

Haemangiosarcomas were the sixth most commonly encountered type of tumour in this survey and accounted for 55% of the blood vessel neoplasms. In a retrospective series of 49 dogs with haemangiosarcoma, Waller & Rubarth (1967) recorded the most common primary sites for this tumour to be the heart, particularly the right atrium, followed by the spleen, peritoneum (especially the omentum) and the liver. They reported the most common sites for subcutaneous haemangiosarcomas to be the shoulder and neck. In the present survey only 4,6% of the haemangiosarcomas arose in the right atrium, whilst 66,4% occurred in the subcutis. It is likely that the latter figures are not a true reflection of the actual distribution of these tumours, as the majority of neoplasms recorded in this survey were obtained from biopsy material removed primarily from the skin.

In several surveys haemangiomas have been reported more frequently than their malignant counterparts (Mulligan, 1949; Sastry & Tweihaus, 1964; Moulton, 1978). Haemangiomas have been reported to occur primarily in the subcutis of the limbs, flank and abdomen and, less frequently, in the head, neck and eyelids (Mulligan, 1949; Mulligan, 1961 a; Moulton, 1978). In this series 96% occurred in the subcutis, especially that of the scrotum and eyelids.

Haemangiopericytomas were the least common of the blood vessel neoplasms, accounting for only 22% thereof. Eighty-one per cent occurred on the limbs and the remainder on the head and abdomen. Smit (1962) recorded the extremities and trunk as the most common sites of origin for these tumours. Mulligan (1961 a) reported that the majority involved the hindlimbs, followed by the forelimbs, abdomen, thorax and head. According to Mills & Nielsen (1967), these tumours occur more commonly in females, especially unspayed females, while German Shepherds, Cocker Spaniels and Springer Spaniels show a predisposition for these tumours.

Lymph vessel tumours occur only rarely in dogs (Mulligan, 1949). Only 4 (0,1%) such neoplasms were recorded in this survey, all of them in the skin.

The histiocytoma is a relatively common tumour of the dog (Moulton, 1978). Moulton (1961, cited by Taylor, Dorn & Luis, 1969), stated that the histiocytoma was first recognized as a distinct tumour in 1961. Before this they had probably been mistakenly diagnosed as mastocytomas, histiocytic lymphosarcomas or TVT. Histiocytomas were first recognized as a distinct neoplasm at this institute from 1964. On re-examination of the preserved tumours collected from the years 1936-1960, several tumours reported as TVT during this period were recognized by the author as histiocytomas. Histiocytomas occur primarily on the head and anterior limbs, although about 30% can arise on the posterior limbs and abdomen (Mulligan, 1949; Mulligan, 1961 a; Taylor *et al.*, 1969). In this series 44% involved the head, whilst the remainder occurred on the limbs. About 50% of histiocytomas occur in dogs less than 2 years of age (Taylor *et al.*, 1969; Moulton, 1978). In this series 44% were younger than 1 year of age, 35% were between 1-3 years, while only 7% occurred in dogs older than 6 years.

Mastocytomas accounted for 12,7% of the total neoplasms and for 37,9% of the mesenchymal tumours. Larsson (1956) reported that mastocytomas accounted for 24% of 144 mesenchymal tissue tumours, whilst Smit (1962) reported that mastocytomas accounted for about 20% of cutaneous tumours. Almost all the mastocytomas in this survey occurred on the skin, especially the scrotum, followed by the head and neck and the limbs. These tumours are reported to involve primarily the skin of the posterior parts of the body and the external genitalia (Mulligan, 1949; Mulligan, 1961 a; Smit, 1962). Mastocytomas generally occur as solitary tumours on the skin (Smit 1962), while about 6-14% can be multiple in type (Mulligan, 1949; Hottendorf & Nielsen, 1967). In this series multiple mastocytomas had an incidence of 10,5%. Boxers and Boston Terriers are predisposed to the development of this tumour, but there is no sex predilection (Hottendorf & Nielsen, 1967). Recurrence of mastocytomas is common, but metastases are rare (Mulligan, 1949; Hottendorf & Nielsen, 1967). In only 7% of cases were metastases reported in this survey.

The cutaneous epithelium and adnexa, very common sites for neoplasia, accounted for 20,8% of all the neoplasms encountered. Basal cell tumours made up 5,1%

of the total tumours and were the most common skin neoplasms (24%), followed by squamous cell carcinomas, perianal gland adenomas and dermal melanomas. Straffuss (1976 a) reported 4,3% of the 3 230 neoplasms as basal cell tumours, whilst in another survey 21% of 153 cutaneous neoplasms were basal cell tumours (Nielsen & Cole, 1960). Mulligan (1949), however, reported only 8,1% of 283 skin neoplasms to be of this type. The head and neck have been reported as the principal sites of origin of this tumour (Mulligan, 1949; Nielsen & Cole, 1960; Smit, 1962; Straffuss, 1976 a). Another favourite site is between the claws (Smit, 1962). In this survey, 59% of these tumours occurred on the head and 24% on the limbs.

Seventy-one per cent of the squamous cell carcinomas in this survey were of cutaneous origin. These tumours also occurred at various other sites, including the penis and prepuce (12%), oral cavity (10%) (in particular, the tonsils, tongue and lips), and the eye and adnexa (6,3%). Sastry & Tweihaus (1964) recorded 9 (56%) of 16 squamous cell carcinomas as involving the skin, whilst the remainder arose on the buccal mucosa, tonsils, eye and trachea. Straffuss, Cook & Smith (1976) reported that 71,4% of squamous cell carcinomas arose on the skin, in particular, that of the limbs, abdomen, head, neck and shoulders, 17,9% in the oral cavity and 10,7% on the eye and adnexa. In this survey, squamous cell carcinomas accounted for 21% of the cutaneous neoplasms. In 2 other surveys, these tumours accounted, respectively, for 5% and 20% of cutaneous neoplasms (Mulligan, 1949; Nielsen & Cole, 1960). According to Nielsen & Cole (1960), squamous cell carcinomas can arise anywhere on the skin. However, sites of preference are the head, limbs, trunk and scrotum (Mulligan, 1949; Smit, 1962; Straffuss *et al.*, 1976; Moulton, 1978). Cotchin (1954, cited by Moulton, 1978) reported tonsillar carcinoma as having a high incidence in certain urban areas supposedly due to high levels of air pollution in those areas.

Squamous papillomas totalled 53 in this survey, the majority (60%) of which involved the skin and 36% the oral cavity, whilst solitary cases arose in the trachea and urinary bladder. These neoplasms accounted for only 3,6% of the cutaneous neoplasms in this survey. Mulligan (1949) reported 2,4% and Nielsen & Cole (1960) 6% of cutaneous neoplasms as squamous cell papillomas. In dogs, cutaneous papillomas usually occur in older animals, can involve any part of the skin and are usually solitary (Moulton, 1978). Oral papillomas, on the other hand, are almost always multiple and occur in young individuals (Smit, 1962; Moulton, 1978).

Sebaceous gland adenomas and carcinomas have been reported as accounting for 5% and 0,83%, respectively, of all canine neoplasms (Straffuss, 1976 b, 1976 c). Moulton (1978) reports sebaceous gland growths as the most common epithelial skin tumours, and Mulligan (1949) noted 21,2% of 283 epithelial cutaneous tumours to be of this type. In this survey sebaceous gland adenomas and carcinomas together accounted for only 9,6% of all the skin neoplasms. Sebaceous gland adenomas may occur anywhere on the skin (Moulton, 1978), but predilection sites are the head (especially the eyelids and ears) and the limbs (Mulligan, 1949; Straffuss, 1976 c). Sebaceous gland carcinomas involve primarily the head (Straffuss, 1976 b). Cocker Spaniels and Fox Terriers are the breeds most susceptible to the development of sebaceous gland tumours (Mulligan, 1949; Straffuss, 1976 b, 1976 c). Adenomas are commonly multiple in origin and frequently occur in conjunction with other cutaneous epithelial neoplasms (Straffuss 1976 c).

Perianal gland adenomas were the ninth most frequently encountered type of neoplasms, with 3,6% of the total 3 388 tumours. Nielsen & Aftosmis (1964) reported perianal gland tumours to be the third most common type of canine neoplasms. These tumours can be solitary or multiple (Mulligan, 1949; Nielsen & Aftosmis, 1964; Moulton, 1978). The majority of these tumours are found surrounding the anus, but they can occur at extra-anal sites, including the tail base, prepuce, thigh and lumbosacral region of the back (Nielsen & Aftosmis, 1964; Moulton, 1978). In this survey, over 80% of the perianal gland tumours occurred in the perianal region. The tail base accounted for 8% and 15%, respectively, of the adenomas and carcinomas. Six per cent of the adenomas occurred on the prepuce. These tumours occur more commonly in males and in spayed, as compared to intact females. Castration or oestrogen administration have been found to aid in the therapy of these tumours (Nielsen & Aftosmis, 1964; Wilson & Hayes, 1979).

In this series of tumours, melanomas occurred primarily on the skin, (62%) followed by the oral cavity (20%), eye (14%) and the scrotum and penis (4%). They were the third most frequently encountered type of neoplasm and accounted for 14,6% of the cutaneous neoplasms, 15,4% of the digestive tract tumours and 43% of the ocular tumours. Mulligan (1949) reported that 65% of 91 melanomas arose on the skin, 33% in the oral cavity and 2% in the eye. Smit (1962), however, noted that oral melanomas were more common than dermal melanomas. Bostock (1979) reported 63% of 134 melanomas to be of dermal origin and the rest to be oral melanomas. The principal sites for dermal melanomas are reported to be the head and anterior limbs (Mulligan, 1961 b). In this survey the majority occurred on the limbs. Eighty per cent of the dermal melanomas in this series were regarded as malignant, whilst Mulligan (1961 b) reported only 51% to be malignant. Mulligan (1961 b) reported 93% of oral melanomas to be malignant and the principal sites for these tumours to be the lips, gingivae, cheeks and palate. All the oral melanomas in this survey were regarded as malignant. Bostock (1979) is of the opinion that, although some oral melanomas may appear as benign morphologically, behaviourally they are all malignant. He proposed that the designation "benign" for oral melanomas should be avoided. The ocular melanomas involved primarily the eyelids, half of which were malignant and the other half benign.

Sweat gland tumours accounted for only 4,7% of the 703 cutaneous neoplasms. Incidences for sweat gland tumours of 9,1% and 11% of cutaneous neoplasms have been reported (Nielsen & Cole, 1960; Christie & Jabara, 1964). According to Crivellini & Pierini (1966), apocrine sweat gland adenomas are frequently multiple in origin.

Twelve adenomas of the ceruminous glands were recorded. Franc, Guaguere, Magnol, Dorchie & De Lahitte (1981) included papillomas, squamous cell carcinomas, basal cell tumours, sebaceous and sweat gland tumours, melanomas, fibrous and cartilaginous tissue tumours and ceruminous gland adenomas as tumours which may arise in the external auditory canal. They state that of all these types of tumours, ceruminous gland neoplasms are the most commonly encountered. In this survey ceruminous gland tumours were the only types of tumours recorded as occurring within the external auditory meatus.

The only other cutaneous neoplasms recorded in this survey were tumours arising from hair follicles. These tumours were rare, only 2,7% of cutaneous tumours being of this type. Nielsen & Cole (1960) recorded 8% of skin neoplasms as arising from hair follicles.

The female genital tract accounted for 10,2% of the total tumours. Of the 322 neoplasms in this system, 80,7% occurred in the mammary gland. By excluding the mammary gland and ovaries, the vagina accounted for 61% of the remaining 44 tumours, the uterus 18%, the vulva 14% and the cervix 7%. In a series of 96 neoplasms of the canine uterus, vagina and vulva, 85% involved the vagina and vulva and only 12% the uterus (Brodey & Roszel, 1967). The most common neoplasms of the uterus, vagina and vulva in this series were fibromas, 68% of which occurred in the vagina, followed by TVT and smooth muscle tumours. Brodey & Roszel (1967) recorded leiomyomas as the most common vaginal, vulval and uterine tumours, followed by TVT and lipomas, but they did not record any fibromas. Mulligan (1949) stated fibromas, neurofibromas and leiomyomas to be the most frequently encountered tumours of the vagina and vulva. Unlike in the cow, uterine adenocarcinomas occur only rarely in the dog (Moulton, 1978).

Granulosa cell tumours were the most common ovarian tumours, accounting for 72% of the 18 ovarian neoplasms. These tumours are reported to produce oestrogens or both oestrogens and progesterone and have been associated with abnormal oestrus activity and signs of hyperoestrogenism (McCandlish, Munro, Breeze & Nash, 1979).

Incidences for mammary tumours, varying from 11-13,8%, have been reported (Mulligan, 1949; Mitchell, De la Iglesia, Wenkoff, Van Dreumel & Lumb, 1974; Priester, 1979). In this survey the mammary gland accounted for 80,7% of the female genital tract neoplasms and 7,6% of the total tumours. Fifty-one per cent of the mammary tumours in this survey were mixed mammary tumours, 27% were mammary carcinomas and 22% mammary adenomas. Mulligan (1949) and Mitchell *et al.* (1974) also reported mixed mammary tumours to occur more commonly than carcinomas. In other surveys, however, mammary carcinomas were more commonly encountered than the mixed tumours (Mulligan, 1975; Else & Hannant, 1979; Priester, 1979). Sixty-three per cent of the mixed mammary tumours in this survey were benign. Moulton (1978) reported about 65% of mammary tumours to be benign mixed tumours and 25% mammary carcinomas. Poodles are reported to have a predisposition for the development of mammary tumours (Mitchell *et al.*, 1975; Priester, 1979). On the other hand, Fanton & Withrow (1981) did not notice any breed predilection. As regards age and sex, mammary tumours are reported to involve almost exclusively unsplayed bitches, especially between the ages 8-13 years (Else & Hannant, 1979; Fanton & Withrow, 1981).

Transmissible venereal tumours were the fourth most commonly encountered neoplasms of the female genital tract. These tumours are usually a coitally transmitted neoplasm of the external genitalia (Oduye, Ikede, Esurioso & Akpokodje, 1973). There is apparently no breed or sex predisposition, and dogs between 4-5 years are the ones usually affected (Brown, Calvert & MacEwen, 1980). Of 38 TVT in this series for which the site of origin could be determined, 39% involved the vagina and vulva, 37% the prepuce, penis or scrotum, 21% the skin and 3% the mouth. Brown *et al.*, (1980) found 28 (94%) of 30 TVT to arise on the penis or vagina, 3% in the mouth and 3% in the nasal passages.

Lymphohaemopoietic neoplasms accounted for 302 (8,9%) of the total tumours in this survey, 295 of which were lymphosarcomas. Mulligan (1949) reported an incidence of only 2,5% of all canine tumours to be lymphosarcomas. The most common forms encountered were the multicentric and alimentary forms, whilst the

skin, thymus and tonsils were also relatively commonly involved. Moulton (1978) also reported the multicentric and alimentary forms as the most frequently encountered canine forms. In one report, cutaneous lymphosarcomas, as part of a generalized lymphosarcomatosis, accounted for 7% of all lymphosarcomas (McKeever, Grindem, Stevens & Osborne, 1982). In this survey cutaneous lymphosarcomas made up 11.3% of 88 cases. This figure may be an overrepresentation, as the majority of tumours were obtained from biopsy material, especially of the skin. In cattle and cats, lymphosarcomas have been proven to be caused by C-type oncornaviruses (Piper, Abt, Ferrer & Marshak, 1975; Mackey, 1975). In sheep and goats, lymphosarcomas have been induced by the inoculation of the bovine leukaemia virus, whilst in pigs, C-type oncornavirus particles have been observed with the electron microscope within the cells of lymphosarcomas (Hoss & Olson, 1974; Moennig, Frank, Hunsmann, Ohms, Schwartz & Schäfer, 1974). Recently, Tomley, Armstrong, De Souza, Wreghitt, Owen & Mahy (1982) noted viral particles with properties similar to those of known retroviruses in cultures of canine lymphosarcomatous and leukaemic tissue cultures.

According to Hayes & Pendergrass (1976), testicular tumours are, in frequency, second only to skin tumours in male dogs. Scully & Coffin (1952) reported testicular tumours to be relatively common canine tumours, usually involving dogs older than 7 years. In this survey, the male genital tract accounted for 5.8% of the total neoplasms. Of the testicular tumours, Sertoli cell tumours made up 52%, seminomas 35% and Leydig cell tumours 13%. Scully & Coffin (1952), however, reported Leydig cell tumours as the most common type, followed by Sertoli cell tumours and lastly seminomas. Hayes & Pendergrass (1976) reported more or less equal incidences for the 3 types of testicular tumours. Nine (11.6%) of the Sertoli cell tumours in this series occurred in retained testes, but all the seminomas and Leydig cell tumours arose in descended testes. Scully & Coffin (1952) noted that 24.2% of Sertoli cell tumours, but no seminomas or Leydig cell tumours arose in retained testes. Cryptorchid dogs have been reported to have an increased risk for testicular neoplasms (Hayes & Pendergrass, 1976; Reif, Maguire, Kenney & Brodey, 1979), as well as dogs with inguinal hernia (Hayes & Pendergrass, 1976). All 3 types of testicular tumours can occur in retained testes, but the majority are Sertoli cell tumours (Hayes & Pendergrass, 1976).

The prostate accounted for only 3.4% of the 233 male genital tract tumours. Weaver (1981) noted that, in the dog, prostatic carcinomas occur rarely.

Other tumours of note in the male genital tract included squamous cell carcinomas, TVT and mastocytomas, arising on the penis and prepuce or scrotum.

The oral cavity tumours, including the odontogenic neoplasms, accounted for 70% of the digestive tract neoplasms. According to Todoroff & Brodey (1979), the oropharynx is the fourth commonest site for malignant neoplasia in the dog. Melanomas, squamous cell carcinomas and fibrosarcomas have been reported as the most commonly encountered neoplasms of the mouth and pharynx (Dorn & Priester, 1976; Todoroff & Brodey, 1979). In this survey, epulides were the most common oral tumours. Although these have been included amongst the oral neoplasms, it is the author's opinion that these are actually hyperplastic in nature, varying from fibrous to osseous in type. After epulides, melanomas were the most frequently encountered oral neoplasms, followed by squamous cell carcinomas, oral papillomas, adamantinomas and fibrosarcomas. The oral melanomas involved the mouth in general, and the

tongue or tonsils, and squamous cell carcinomas the tonsils, tongue, lips and gums. Other workers have reported similar sites of origin for both these neoplasms (Dorn & Priester, 1976; Todoroff & Brodey, 1979). According to Todoroff & Brodey (1979) almost all oral melanomas and tonsillar squamous cell carcinomas and about a third of oral fibrosarcomas metastasize to other sites.

Adamantinomas have been reported to be relatively rare oral neoplasms (Langham, Keahey, Mostosky & Schirmer, 1965). In this survey 15 (10%) of the oral cavity neoplasms were regarded as adamantinomas and 5 (3.4%) as fibromatous epulides of periodontal origin. Langham *et al.* (1965) reported 8.7% of oral tumours as adamantinomas. They noted that these tumours involved the mandibles more commonly than the maxillae. There exists much confusion as regards the nomenclature of periodontal tumours. Dubielzig, Goldschmidt & Brodey (1979) suggested that periodontal tumours be classified into 3 types, namely fibromatous epulis, ossifying epulis and acanthomatous epulis. However, according to Thrall, Goldschmidt & Biery (1981), acanthomatous epulides are distinct from adamantinomas. The author is of the opinion that canine odontogenic neoplasms should be classified under 3 types, namely, adamantinomas, fibromatous epulides of periodontal origin and odontogenic neoplasms, which produce dentin or enamel.

The 26 oesophageal tumours encountered in this survey had all developed as a result of a chronic *Spirocerca lupi* infestation. The majority of these were osteosarcomas and fibrosarcomas, while only 1 chondrosarcoma was recorded. According to Bailey (1963), *S. lupi* incites a granulomatous lesion in the oesophagus which differs from the usual chronic inflammatory response in its pronounced vascularity as well as the looseness and embryonal appearance of the fibroblasts. He believes the immature appearance of these cells is suggestive of a preneoplastic state which can progress to the development of a fibrosarcoma or osteosarcoma. He reported that 67% of 39 *S. lupi*-induced oesophageal tumours contained bone. In this series 65% of the 26 oesophageal tumours were osteosarcomas.

The intestine accounted for only 11.2% of the digestive tract tumours, 50% of which were adenocarcinomas, 42% lymphosarcomas and 8% adenomas of the rectum. Patnaik, Hurvitz & Johnson (1980) reported 88% of 35 intestinal neoplasms to be adenocarcinomas and 12% carcinoids. They noted that the adenocarcinomas were primarily of the acinar or mucinous type and that they involved predominantly the duodenum, colon and rectum. According to Seiler (1979) and Patnaik, Hurvitz & Johnson (1980), colorectal polyps (adenomas) may be premalignant forms of intestinal adenocarcinomas.

Cotchin (1956, cited by Owen, 1966) found 4% of canine tumours arose in the skeletal system. In this series they accounted for 2.9%. Osteosarcomas accounted for 77.8% of the 99 skeletal tumours. This tumour has previously been reported as the most common bone tumour (Brodey, Sauer & Medway, 1963; Owen, 1966). In one report, over half of the osteosarcomas occurred in dogs 5-9 years of age (Owen, 1966). Others have reported the mean age for these neoplasms to be about 7.5 years (Brodey *et al.*, 1963; Wolke & Nielsen, 1966). In dogs under 4 years of age, the principal site of origin is the ribs (Owen, 1966). In this series 13.4% involved the ribs. Males are more susceptible than females in ratios varying from 1.4:1 or 1.3:1 (Owen, 1966; Brodey *et al.*, 1963). Larger breeds have been observed to be more prone to developing osteosarcomas, especially Great Danes and St. Bernards (Brodey *et al.*, 1963; Owen, 1966; Wolke & Nielsen, 1966). These workers have also shown that in older dogs, the principal site of origin is

undoubtedly the distal radius, whilst the proximal humerus and distal tibia are also common sites. In this survey a third of the bone tumours involved the humerus. According to Owen (1966) and Wolke & Nielsen (1966), the forelimbs account for more osteosarcomas than the hindlimbs, as the former bear proportionately more of the body mass than the latter.

Osteomas were rare, accounting for only 4% of the skeletal tumours in this survey. According to Brodey *et al.* (1966), benign bone tumours are seldom observed in dogs, since they noted only 2 (1,3%) benign tumours out of 152 bone tumours.

Tumours of cartilaginous origin occurred much less frequently than osseous tissue tumours and only 14,2% were either chondromas or chondrosarcomas. Incidences of 8% and 15% for cartilaginous tumours have been reported (Brodey *et al.*, 1966; Goedegebuure, 1979). Chondrosarcomas generally involve flat bones, and, in particular, the skull and ribs (Brodey *et al.*, 1963). The bones of origin of the majority of chondrosarcomas in this series could not be ascertained, but one involved the scapula and another a rib. A miscellany of other tumours can arise as primary bone tumours, including haemangiosarcomas, fibrosarcomas, lymphosarcomas and liposarcomas (Brodey *et al.*, 1963; Goedegebuure, 1979). In this survey, the skeletal system accounted for 1,7% and 11,9% of 59 fibromas and fibrosarcomas, respectively, as well as 3% of 65 haemangiosarcomas.

Only 4% of the bone tumours in this series were osteoclastomas. Brodey *et al.* (1963) did not encounter any of this type among 152 bone neoplasms. These tumours are reported to be exceptionally rare canine bone tumours, but have been recorded as arising in the metacarpals, humerus, atlas and radius (Moulton, 1978; Garman, Powell & Tompsett, 1977).

Thyroid tumours were relatively common canine tumours, accounting for 1,3% of the total neoplasms. They were the most common endocrine tumours, 78% of them being carcinomas, 20% adenomas and 2% mixed thyroid tumours. In a series of 1 377 canine neoplasms 16 (1,2%) were of thyroid origin, 14 of which were carcinomas and 2 adenomas (Birchard & Roesel, 1981). These authors noted that Boxers are predisposed to the development of thyroid tumours, but that there is no sex predilection. A prime symptom for all thyroid tumours is the presence of a neck mass. Other symptoms include vomiting, coughing, anorexia, dyspnoea and loss of mass, whilst about 50% of thyroid tumours spread along the jugular veins to the lungs (Birchard & Roesel, 1981).

Chemodectomas were the second most frequently encountered canine endocrine tumours, although they accounted for only 10,6% of the total. These are highly vascular tumours arising in either the aortic or carotid bodies. The majority involve the aortic bodies, hence the term heart base tumours (Nilsson 1955; Yates, Lester & Mills, 1980). Boxers and Boston Terriers are predisposed to this tumour and males are more susceptible than females (Yates *et al.*, 1980).

Adrenocortical adenomas and pancreatic β cell carcinomas were relatively common endocrine tumours in this survey. Of all the domestic animal species adrenal adenomas are reported to occur the most commonly in dogs (Moulton, 1978). Canine β cell pancreatic neoplasms are frequently reported to be functional, hence the excessive insulin secretion and hypoglycaemia (Moulton, 1978).

Tumours of the central nervous system (CNS) are not as uncommon as was formerly believed (Luginbühl, 1963; Moulton, 1978). In this survey, however, the nervous system accounted for only 1,7% of the total tumours, only 26% of which arose in the CNS. The low incidence in this survey probably reflects the fact that the majority of tumours were obtained from biopsy material and not from post-mortem material. Most of the glial neoplasms in this survey were either astrocytomas or glioblastomas, followed by oligogliomas. Luginbühl (1963) reported oligogliomas as the most common neuroectodermal neoplasms, accounting for 48% of the latter. He noted that Boxers and Boston Terriers have a predisposition to glial tumours. Meningiomas accounted for 46% of the CNS tumours in this series. Luginbühl (1963) noted that meningiomas were the most common tumours of mesodermal origin in the brain, even though they accounted for only 9% of a series of 237 CNS neoplasms.

Tumours of the peripheral nerves accounted for 76% of nervous system neoplasms, 95% of which arose from the connective tissue cells around nerve fibres, whilst only 5% were schwannomas. In a series of 770 canine mesenchymal and neurilemmal tumours, Mulligan (1961 a) reported an incidence of 3,2% for neurofibromas and neurofibrosarcomas.

The eye and adnexa made up 1,4% of the total tumours, the principal neoplasms being melanomas and tumours arising from the squamous epithelium and adnexa of the eye. A ciliary body adenoma was encountered in this series. According to Moulton (1978), this is a common primary ocular tumour, second only in incidence to ocular melanomas.

The nasal cavity and sinuses accounted for 32,5% of the respiratory system neoplasms, the majority being nasal carcinomas. Nasal and paranasal tumours have been reported as accounting for 0,6-1% of all canine neoplasms (MacEwen, Withrow & Patnaik, 1977; Confer & De Paoli, 1978; Hayes, Wilson & Fraumeni, 1982). These reports showed that the majority of nasal tumours are malignant, of epithelial origin, and arise from the surface respiratory epithelium. Dolicocephalic breeds, especially Collies and Shelties, were reported to be more susceptible than brachycephalic breeds, probably because in geographic areas where there is high industrial activity carcinogens attain higher concentrations in the former breeds compared to the latter, as brachycephalic breeds tend to breathe more through their mouths than their nostrils. In this survey, nasal and paranasal tumours accounted for 0,4% of the total tumours.

Sixty-five per cent of the respiratory system tumours arose in the lungs. Of the 28 pulmonary tumours, the majority (71%) were adenocarcinomas followed by epidermoid carcinomas (15%), combined epidermoid and adenocarcinomas (7%) and adenocarcinomas arising from the bronchial mucous glands (7%). In a series of 29 primary pulmonary tumours, Brodey & Craig (1965) recorded 28 carcinomas and 1 fibrosarcoma. The carcinomas in the latter report included squamous or anaplastic carcinomas, adenocarcinomas or combinations thereof. They showed that Boxers have a predilection for pulmonary tumours, that these neoplasms do not affect any lung lobes preferentially, that they are generally multiple due to lymphatic, haematogenous and bronchogenous metastases within the lungs and that a common clinical symptom in dogs with pulmonary neoplasms is a non-productive cough.

Primary hepatic neoplasms are rare in all domestic animals, including dogs, in which species they account for 0,6-1,3% of all neoplasms (Patnaik, Hurvitz & Lieberman, 1980). In this survey, the liver and biliary tree

accounted for 1% of the total tumours. Malignant hepatic tumours are more common than benign tumours (Trigo, Thompson, Breeze & Nash, 1982). Hepatocellular carcinomas are generally more commonly encountered than cholangiocarcinomas (Patnaik *et al.*, 1980), but in this survey, cholangiocarcinomas were more common (52%) than hepatocellular carcinomas (39%). Trigo *et al.* (1982) noted an almost equal incidence for these 2 types of tumours. Both tumours are reported to metastasize readily, although cholangiocarcinomas reportedly metastasize at a higher rate than hepatocellular carcinomas (Patnaik *et al.*, 1980). The principal clinical signs associated with hepatic tumours include vomiting, anorexia, polydipsia and mass loss (Strombeck, 1978; Patnaik *et al.*, 1980; Trigo *et al.*, 1982).

The urinary system accounted for only 25 (0.7%) of the total tumours, the majority (48%) being transitional cell carcinomas of the urinary bladder or renal pelvis. Theilen & Madewell (1979) reported urinary bladder tumours to be rare tumours, accounting for 0.5% of all canine tumours. Other tumours encountered in the urinary system in this survey included renal adenocarcinomas and adenomas, embryonal nephromas and a urinary bladder papilloma. Renal adenomas and adenocarcinomas as well as embryonal nephromas are rarely encountered in dogs (Moulton, 1978).

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