

PATHOLOGICAL STUDIES ON NEOPLASMS OF DOGS IN SOUTH AFRICA

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INTRODUCTION

In 1956 studies on neoplasms of dogs were commenced at the Liesbeek Clinic. De Kock (1957a) stressed the importance of these investigations, especially in respect of their comparative value to the study of neoplasms in man. Suitable forms were circulated amongst veterinarians and these were based on the observations published in a number of overseas journals. In such a survey of tumours in dogs in South Africa, special attention should be paid to geographical, breed, age, sex and site incidences, as well as to clinical data. The importance of careful autopsies was stressed for a proper reorientation of the site and nature of the tumour and the problem of metastasis, and the possible occurrence of multiple primary tumours. It entailed the proper selection of specimens and suitable smears for microscopical studies in order to arrive at a histological diagnosis.

Large numbers of tumours in dogs have been investigated and described, e.g. by Feldman (1932), Jackson (1936), Innes (1943), Mulligan (1949), and others. Head (1959) and Cotchin (1959) have so far investigated close on 9,000 tumours in dogs. Jackson indicates that a full history of the subject, and a careful description of the specimen *in situ* are of great importance to the pathologist. Innes maintains that unless meticulous autopsies with histological examination are made on a long series of animals, many tumours may evade recognition or accurate diagnosis. The effective classification of neoplasms, according to Jackson, is one of the most subtle problems of pathology. There is a multiplication of nomenclature on the basis of variation of morphological appearance. He maintains that proliferative processes may be variously classed as nodular hyperplasia or as an adenoma in such organs as the liver, spleen, prostate, etc., and difficulties also arise in deciding whether one is dealing with a benign or a malignant tumour.

Further comment on certain aspects of the pathology of tumours raised in the literature will be referred to when the results of the investigations at the Liesbeek Clinic are considered.

MATERIAL AND METHODS

Dogs, believed to be affected with tumours, were received at the Liesbeek Clinic for investigation and diagnosis. Some of them with visible tumours revealed slight symptoms, whereas in others anaemia, emaciation, and even coma were present. In a few cases tumours were detected on the palpation of a distended abdomen. Some dogs were killed, others were dead before they arrived. A number of apparently clinically healthy dogs used for lymph tapping (Silk & Mears, 1959) was autopsied for comparative studies.

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Smears were made from the blood according to Nesor's method (1923), and stained with Giemsa. The sites and nature of the tumours and the possible presence of metastasis were recorded. Suitable specimens were selected from tumours and other organs, and imprint smears made and stained with Giemsa, and in some cases the Papanicolaou method was applied. The specimens were then fixed and subsequently embedded, and stained sections prepared. In all cases the haematoxylin-eosin method was applied, and in several cases the van Gieson method and Weigert's reticulin stain were used, as well as the Sudan III stain for frozen sections.

A number of specimens of tumours, including those removed surgically, was submitted in 10 per cent formalin for a diagnosis. Important information such as history, symptoms, site of these tumours, etc., was usually unsatisfactory. In a number of cases the specimens were badly selected, or not properly fixed.

RESULTS

The results will embrace a brief reference to the age of the dogs, and a consideration of the tumours investigated, as well as comment on the pathology of some of them.

In Table 1 the tumours observed in dogs autopsied at the Liesbeek Clinic have been briefly tabulated in respect of breed, age, whether it died or was killed, site of the tumour and diagnosis. Hyperplasias in such organs as the spleen, adrenal, prostate and liver, are recorded.

Table 2 reflects the available records, and the diagnosis arrived at in a number of specimens submitted for examination.

In Table 3 hyperplasias are recorded in the spleen, liver and prostate of dogs in which no neoplasms were identified.

In view of the limited number of cases so far investigated at the Liesbeek Clinic, no opinion of breed incidence could be expressed. Cotchin (1959) maintains that a more complete survey of dogs as well as of those affected with tumours may reveal interesting results, and he mentions some examples of apparent breed susceptibility to different kinds of neoplasms.

In dealing with 4,157 tumours investigated by Cotchin in London (1959), and with 4,555 tumours by Head in Edinburgh (1959), interesting information about site incidence is revealed. The following systems of origin are quoted by Cotchin: skin 37.5 per cent, female genitalia and mammary gland 25.9 per cent, alimentary system 14 per cent, male genitalia 7.1 per cent, skeleton 3.9 per cent, lymphatic 3.8 per cent, and miscellaneous 7.6 per cent. Head, during the discussion at the Conference in 1959, finds a large degree of agreement between the tumour patterns in London and Edinburgh. More skin tumours were, however, observed in the Edinburgh collection, and fewer bone tumours as compared with London. Both Jackson (1936) and Mulligan (1949) refer to the high incidence of cutaneous tumours in dogs. The infrequency of tumours in the viscera of dogs is rather striking when compared with the incidence in man. Is this perhaps due to the fact that dogs mainly affected with visible tumours are submitted by owners for an investigation?

TABLE 1.—Autopsies on Dogs with Tumours

Path. No.	Age (years)	Breed	D: Died K: Killed	Diagnosis	Metastasis	Spleen	Prostate	Adrenal	Liver	
1	7	Bull Terrier.....	K	Prepuce: basal-cell epithelioma.....	—	—	—	—	—	—
3	12	Dobermann.....	K	Peri-anal region: carcinoma.....	Sacral lymph nodes	H	H	—	—	Sclerosis: glomeruli, kidney.
16	13	Spaniel.....	K	Parotid salivary gland: carcinoma.....	Lymph nodes, heart, lungs	—	—	—	—	—
17	3	Spaniel.....	K	Toe: reticulum-cell sarcoma.....	Lymph nodes.....	—	—	—	—	—
23	1	Boxer.....	K	Ethmoid: carcinosarcoma.....	—	—	—	—	—	—
26	13	Setter.....	K	Dorsal aspect humerus: chondrosarcoma	Liver + lung.....	H	—	—	—	—
28	12	Cross-bred.....	K	Liver-cell carcinoma.....	—	H	H	—	—	—
33	Aged	Airdale.....	D	Shoulder region: capillary haemangioma	—	—	—	—	—	—
34	—	Fox Terrier.....	K	Liver-cell carcinoma.....	—	—	—	—	—	—
36	Aged	Dobermann.....	K	Left mandibular region: chondrosarcoma	Lung.....	H	H	H	—	—
39	9	Alsatian.....	K	Proximal part of humerus: chondrosarcoma	—	H	H	H	—	Sclerosis: glomeruli, kidney.
40	8	Dobermann.....	D	Spleen: reticulum-cell sarcoma.....	Liver.....	—	—	—	—	—
42	7	Ridgeback.....	K	Right kidney: carcinoma.....	—	—	H	H	—	Left kidney; nephritis.
64	15	Wire Haired Terrier	K	Intestine: adenoma.....	—	H	—	—	H	—
68	Aged	Airdale.....	K	Neoplasia: testes.....	—	H	H	—	—	—
72	7	Scottie.....	K	Spleen, lymph nodes, liver: myelogenous leukaemia	—	—	H	H	—	—
74	8	Scottie.....	K	Uterus: leiomyosarcoma.....	—	—	—	—	H	—
84	11	Ridgeback.....	K	Liver, spleen, prostate: haemangioma..	—	H	H	H	—	—
101	11	Wire Haired Terrier	K	Descended and undescended testes: neoplasm	—	—	—	H	—	—
102	9	Aberdeen Terrier...	K	Lympho-sarcoma with leukaemia.....	—	—	—	—	—	—
154	6	Dobermann.....	K	Lympho-sarcoma.....	—	—	H	—	—	—
157	12	Wire Haired Terrier	K	Liver: angiosarcoma.....	—	—	—	—	—	—
162	13	Cross-bred.....	K	Wing of atlas: giant-cell sarcoma.....	—	—	H	H	—	—
163	11	Fox Terrier.....	K	Neoplasm: testis.....	—	H	H	—	—	—
171	11	Toy Pom.....	K	Mamma: fibro-epithelioma.....	—	—	—	—	—	—
174	1½	Bull Dog.....	K	Vagina: transmissible venereal tumour.	—	—	—	H	—	—
187	13	Fox Terrier.....	K	Anus: transmissible venereal tumour..	—	—	—	—	—	—
196	9	Great Dane.....	K	Right hip joint: chondrosarcoma.....	Lung.....	—	—	—	—	—
236	6	Great Dane.....	K	Left carpal joint: osteo-sarcoma.....	—	H	—	H	—	—
336	5	Ridgeback.....	K	Left shoulder joint: chondrosarcoma...	Lung and kidney...	H	—	H	—	—
378	—	Bull Terrier.....	K	Prepuce: squamous epithelioma.....	Lymph nodes.....	—	H	—	—	—
379	10	Bull Dog.....	K	Left mandibular salivary gland: carcinoma	Lung.....	—	H	—	—	—
388	11	Scottie.....	K	Lympho-sarcoma.....	—	—	H	H	—	Bladder: fibro-epithelioma.
389	—	Cross-bred.....	K	Spleen: reticulum-cell sarcoma.....	Liver.....	—	—	H	—	—
416	—	Bull Terrier.....	K	Epicardium and colon: neuroblastoma.	—	—	—	H	H	—
470	10	Irish Setter.....	K	Right stifle joint: osteo-sarcoma.....	Spleen, myocardium, kidney	—	—	H	H	Teat: fibro-epithelioma.
494	6	Gorgi.....	K	Ethmoid: carcinosarcoma.....	—	H	—	—	—	—

H = Hyperplasia.

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TABLE 2.—*Specimens of Tumours Submitted for Diagnosis*

Path. No.	Age (years)	Breed	Diagnosis
P2	9	Dobermann.....	Mamma: Fibroma.
P5	3	Fox Terrier.....	Intestine: carcinoma.
P7	12	Fox Terrier.....	Peri-anal: adenoma. Neoplasia testis.
P18	—	Boxer.....	Adrenal: carcinoma. Metastasis: spleen and liver.
P21	15	Mongrel.....	Ovary: reticulum-cell sarcoma. Metastasis: spleen, liver and lung.
P61	—	Pug.....	Lower jaw: fibroma.
P81	8	Alsatian.....	Mouth: reticulum-sarcoma.
P86	—	Alsatian.....	Penis: transmissible venereal tumour.
P89	1½	Boxer.....	Skin: front leg: transmissible venereal tumour.
P107	7 months	Bull Dog.....	Right membrana nictitans: lymphoid hyperplasia.
P110	10	Dachshund.....	Mamma: papilliform cyst-adenoma.
P121	11	Bull Terrier.....	Prepuce: squamous epithelioma.
P152	—	—	Peri-anal: adenoma.
P166	9	Collie.....	Vagina: fibro-sarcoma.
P167	12	Fox Terrier.....	Testes: neoplasia.
P188	7	Afghan.....	Prostate: hyperplasia.
P216	3	Great Dane.....	Penis: transmissible venereal tumour.
P220	10	Wire Haired Terrier.	Ventral aspect abdomen: fibro-sarcoma, with metaplasia (cartilage).
P222	8	Maltese Terrier....	Descended and undescended testis: neoplasia.
P225	11	Alsatian.....	Mamma: papilliform cyst-adenoma.
P251	10	Fox Terrier.....	Prostate: hyperplasia.
P255	8	Scottie.....	Kidney: carcinoma. Metastasis: liver.
P259	8	Dachshund.....	Mamma: carcinosarcoma.
P260	10	Dachshund.....	Shoulder region: carcinosarcoma.
P262	—	Wire Haired Terrier.	Testis: neoplasm.
P264	16	Scottie.....	Region of head: skin: neurogenic sarcoma.
P271	2	French Poodle....	Mamma: fibroma.
P301	14	Cross-bred.....	Abdominal wall: skin: capillary haemangioma.
P344	6 months	Alsatian.....	Tongue: epidermoid carcinoma.
P456	7	Dachshund.....	Mamma: fibro-sarcoma.
P471	6	Ridgeback.....	Upper jaw: fibro-sarcoma.
P472	6 months	Collie.....	Vagina: transmissible venereal tumour.
P495	—	Dobermann.....	Lympho-sarcoma: lymph nodes and spleen.
P505	—	—	Hock: fibro-sarcoma.
P506	—	—	Jaw bone: squamous epithelioma.

With reference to the multiplicity of primary neoplasms in dogs, it may be mentioned that in our cases more than one primary tumour occurred in nine dogs. This did not include the hyperplasias observed in the liver, spleen, and prostate. Feldman described the following neoplasms in a 13-year old dog: (i) squamous-cell carcinoma of the gum; (ii) multiple haemangioma of the liver; (iii) leiomyosarcoma of the caecum; (iv) interstitial-cell tumour of the testis; (v) papillary cyst-adenoma of the prostate; and (vi) lymphomatous nodules in the spleen. Is it not possible that some of these were of the nature of hyperplasia and not benign neoplasms? According to Mulligan (1948) of 98 dogs, 83 had one neoplasm, nine had two, five had three, and one had four.

TABLE 3.—Autopsies on Dogs, Died or Killed, after Lymph Tapping, or due to Other Causes

Path. No.	Age (years)	Breed	D: Died K: Killed		Spleen	Prostate	Adrenal	Liver
P9	6	Cross-bred.	K	—	H	H	H	
P13	—	Alsation...	K	Lymph tapping.				
P14	—	Dobermann	K	Lymph tapping.	H			
P22	—	—	K	Lymph tapping.				
P27*	—	Spaniel...	K	Lymph tapping.	H			
P38	—	Alsation...	K	Lymph tapping.				
P41	15	Fox Terrier	K	Liver: hyperplasia	H			
P49	Aged	Alsation...	K	Lymph tapping.		H		
P50	14	Mongrel...	K	Microfilariasis..	H	H	H	
P85	9	Mongrel...	K	—		H	H	
P108†	—	Mongrel...	K	Liver: hyperplasia				H
P111	12	Scottie....	K	Liver: hyperplasia		H	H	H
P150	3	Bull Dog..	D	—	H	H		
P158‡	13	Alsation...	D	—		H	H	
P199	—	Dobermann	K	Lymph tapping.				

P27 * = Nodule spleen, 1½ cm. in diameter; dark red in colour.

P108 † = Spleen divided into two sections; shape abnormal.

P158 ‡ = Spleen in two portions; together form the shape of spleen, but the organ is swollen.
H = Hyperplasia.

In Table 4 the age incidence of our dogs affected with neoplasms is recorded:

TABLE 4

Years.....	½	1	1½	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Aged
No. of Cases....	2	1	2	1	4	—	1	3	5	6	5	6	8	5	4	1	2	1	2

In a few cases the ages were not submitted. It would therefore appear that the majority of cases occurred between the ages of seven and 13 years. According to Cotchin (1956) the incidence of neoplasms in dogs increases with age, the average age being about eight years. Mulligan (1948) records that 80 dogs amongst 98 with neoplasms were six years and older.

The following neoplasms were observed in dogs at the Liesbeek Clinic prior to the sixth year:—

- (i) Epidermoid carcinoma, tongue, Alsation, six months (P344*);
- (ii) Transmissible venereal tumour, vagina, Collie, six months (P472);
- (iii) Carcinosarcoma, ethmoid, Boxer, one year (P23);
- (iv) Transmissible venereal tumour, vagina, Bull Dog, one-and-a-half years (P174);
- (v) Transmissible venereal tumour, skin, front leg, Boxer, one-and-a-half years (P89);

* These numbers refer to the cases recorded in Tables 1 to 3.

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- (vi) Fibroma, mammary gland, French Poodle, two years (P271);
- (vii) Reticulum-cell sarcoma; skin, toe, Spaniel, three years (P17);
- (viii) Transmissible venereal tumour, penis, Great Dane, three years (P216);
- (ix) Carcinoma, intestine, Fox Terrier, three years (P5);
- (x) Chondrosarcoma, shoulder joint, Ridgeback, five years (P336).

Cotchin (1959) refers to a number of malignant tumours in young dogs from under one year to four years. Under one year there were two malignant tumours of the kidney. There were cases of osteosarcoma from 12 months on, and at three years there was one case of carcinoma of the mammary gland, and in two cases carcinoma of the intestine was diagnosed.

A BRIEF CONSIDERATION OF THE TUMOURS OBSERVED IN THE VARIOUS ORGANS AND TISSUES (SEE TABLES I AND II)

Bone Marrow

A *myelogenous leukaemia* was diagnosed in a seven-year-old Scottie (P72) killed for autopsy. The lymph nodes and spleen were much enlarged, and in the liver large nodular swellings were observed. The blood was so thin that difficulty was experienced in making proper smears. In it neutrophils were frequent, and myelocytic types were also identified. Immature polymorph-types of cells predominated in the smears prepared from the lymph nodes and the bone marrow.

Lymphatic System

(a) Four cases of *lymphosarcoma* were diagnosed in the following organs: (i) Lymph nodes, spleen and mesentery; Dobermann, six years (P154); (ii) Lymph nodes, spleen and mesentery; Scottie, 11 years (P388); (iii) Lymph nodes, spleen, liver and kidney; Aberdeen Terrier, nine years (P103); (iv) Lymph nodes and spleen; Dobermann (specimens) (P495).

(i) In the case of the six-year-old Dobermann (P154), the mucous membrane of the caecum and colon to the anus was much swollen, and dark red in colour. The mesentery at its attachment to the intestine looked somewhat like pancreatic tissue, and from the caecum to the anus showed nodular swellings. The caecum and appendix were involved in a large tumour mass about the size of an ostrich egg.

(ii) The imprint smears from the lymph nodes and liver in the nine-year-old Aberdeen Terrier (P103), revealed many immature types of lymphocytic cells, and in the blood smear they were not infrequent.

Cotchin (1956) maintains that lymphatic leucosis is quite common in dogs, and besides the spleen, liver and lymph nodes, the other viscera are also affected. He records 20 per cent of cases of lymphosarcoma of the intestines in 160 tumours of the alimentary tract in dogs.

The terminology of lymphosarcoma was adopted in our studies. Except for the demonstrable presence or absence of malignant cells in the blood, there appears to be, according to Willis (1955), no difference between lymphosarcoma and lymphatic leukaemia. He believes that the so-called lymphocytoma, lymphoblastoma, and the syncytial reticulo-sarcoma are degrees of differentiation towards that of lymphoid tissue, which they may attain.

Of interest is the question raised by Willis as to whether the lymphosarcoma is an extension as metastasis to multiple groups of lymph nodes and other tissues, or whether it is due to a multicentric origin. He believes that both processes may occur, and evidence of a metastasis is the frequent colonisation of the lungs, heart, kidneys, skin, etc., histogenically unrelated to the lymphoid tissue. De Kock (1957b) in his studies on the lesions of Theileriosis in the bovine, refers to the regular and often extensive aggregates of lymphocytic cells appearing in the liver, kidney, adrenals, and less frequently in such organs as the lungs, myocardium, skeletal muscle, pancreas, hypophysis and thyroid. There appears to be, according to him, a "potential stem cell" widely distributed throughout the body, which under stress could proliferate to produce the lymphocytic type of cells. The elimination of the lymphocytic cells (by the Theileria parasite) in the primary lymphoid depots probably led to a compensatory formation of these cells in other parts of the body.

(b) Only four cases of *metastasis in the lymph nodes* were recorded in the following neoplasms: (i) peri-anal carcinoma (P3); (ii) carcinoma of the parotid salivary gland (P16); (iii) reticulum-cell sarcoma of the skin of the toe (P17); and (iv) carcinoma of the prepuce (P378).

Cotchin (1959) is of opinion that it would appear that metastasis is restricted in animals, because malignant neoplasms are generally not allowed to survive for the possible course of the disease.

(c) A seven-month-old Bull Dog (P107) revealed a *small tumour* about the size of a bean and grey-white in colour. It was situated on the *conjunctiva* of the right eye. Below the epithelium, which was partly destroyed, there were clusters of lymphocytic cells, that had infiltrated into what looked like the lacrimal gland. In places it almost resembled a lymph nodule. Minute lymph nodules occurred in the membrana nictitans, and the deep part of the cartilage was surrounded by a gland, which resembled the lacrimal gland in structure. Was this tumour of the nature of a *hyperplasia* or a lymphosarcoma? Willis (1955) refers to aggregates of lymphocytes that are not unusual in the conjunctiva, and sometimes masses, one or more cm. in diameter, occur. They have often been thought to be lymphosarcomatous.

Spleen

1. *Neoplasms*

Two cases of a *reticulum-cell sarcoma of the spleen*, with metastasis in the liver, were investigated.

(i) An eight-year-old Dobermann (P40) revealed, besides evidence of emaciation and ascites, a large fibrous tumour, 10 × 13 cm. in the spleen, as well as a number of smaller greyish-white nodules. The red and white pulps were disintegrated by what appeared to be irregular columns of reticulum cells, with irregular whorls of argyrophilic fibrils, when stained for reticulin. The liver was atrophied, and studded with smaller nodules, more or less of the same nature as observed in the spleen.

(ii) A cross-bred, age not specified (P389), showed a large tumour with smaller nodules in the spleen. Some of the latter were raised above the capsule. In the liver there were multiple light brown areas. Imprint smears of the spleen and the liver revealed clusters of reticulum-cell types.

In three dogs the following primary neoplasms revealed *metastasis in the spleen*, viz. (i) carcinoma of the adrenal (P18); (ii) reticulum-cell sarcoma of the ovary (P21); (iii) osteosarcoma of the stifle joint (P470).

2. *Hyperplasia of the Malpighian bodies and/or haemangioma-like lesions in the red pulp of the spleen.*

In 12 dogs affected with neoplasms and in six dogs without tumours, the above lesions were recorded. The ages of these dogs, where specified, varied from five to 13 years. In some cases it was difficult to decide whether the hyperplasia of the Malpighian bodies, and some of the haemangioma-like changes, were of the nature of an early benign neoplasm. In these cases there was no definite evidence of an invasive growth.

These spleens revealed nodules, some protruding above the capsule of the spleen, and they varied in number, size and colour. In some cases they were few in number, up to about 6 cm. in diameter, whereas the smaller nodules, about 0.5 to 1 cm. in diameter, were usually more frequent. The colour varied from a greyish to dark reddish blue, especially in the large nodules. They were usually situated in the ventral aspect of the spleen, or along its borders. In a number of cases the lesions in the same spleen varied in the sections prepared from different levels. The section from one level would reveal hyperplasia of the Malpighian bodies, whereas at another level cavernous-like dilatations of the sinuses of the red pulp with atrophy of the Malpighian bodies were observed.

The lesions encountered in the spleen of some of the dogs will be briefly referred to.

(i) In a 12-year-old Dobermann the changes varied in different sections of the spleen. The large, dark reddish-blue nodules seen at autopsy, revealed enlarged, irregularly shaped Malpighian bodies, the one integrating into the other, and in places with haemangioma-like lesions dovetailed between the lymphoid tissue. In another part of the same spleen, circulatory changes with prominent trabeculae predominated.

(ii) More or less similar lesions were encountered in the spleen of an aged Dobermann (P36), and in a 15-year-old Wire Haired Terrier (P64). Fairly extensive fibrosis was observed in these two cases.

(iii) An 11-year-old Ridgeback (P84) revealed different lesions in sections from three levels: (a) haemangioma-like changes with atrophy of the Malpighian bodies; (b) very irregular distribution of the white and red pulps; (c) in the third section in places the lesions somewhat resembled a lymphosarcoma, in places with large caverni with blood.

(iv) A six-year-old Great Dane (P236) showed in the one section of the spleen marked hyperplasia of the Malpighian bodies, irregular in size and shape. In places the trabeculae were very prominent with haemangioma-like lesions. In another section of the spleen slight hyperplasia affecting only a few Malpighian bodies with slight circulatory changes in the red pulp was observed, but with very prominent trabeculae.

In order to obtain a true perspective of the structure of the spleen in aged dogs, it would therefore seem advisable to study serial sections at various levels. Nieberle & Cohrs (1931) refer to the frequent occurrence in aged dogs of nodules of the sub-capsular region of the spleen, and protruding above the capsule. Their colour varied from greyish-white to blood red. The follicles according to them were markedly enlarged, and the pulp between them was rich in blood. They could not

regard these as true neoplasms, but more of the nature of a hyperplasia. They also refer to the frequent occurrence of non-malignant haemangioma in the spleen of aged dogs. Mulligan (1949) states that haemangioma of the spleen in aged dogs may be primary neoplasms, whereas the nodular hyperplasia of the lymphoid tissue is common in dogs.

Prostate

In 15 dogs (see Table 1) with primary tumours in other organs, and with ages ranging from seven to 13 years enlargement of the prostate was recorded, whereas in five dogs (see Table 3) with no primary neoplasms, similar lesions were observed. The changes were of the nature of a *hyperplasia* of the glandular tissue with or without a *hypertrophy* of the fibromuscular tissue. It was difficult to decide in some of the cases whether the changes were of the nature of an early papilliform cystadenoma. In these cases the prostate revealed a fairly symmetrical enlargement up to the size of a tennis ball. In none of the cases was there evidence of an irregular invasive form of growth into the surrounding tissues or of a metastasis. The acini were increased in size and the lumen presented a cystic appearance, with a clear fluid emanating from the cut surface. A number of characteristic papilliform ingrowths were observed in the lumen of the acini. In a few cases this hyperplasia of the glandular tissue was also associated with a hypertrophy of the fibromuscular tissue (P68 and P85).

Hyperplasia of the enlarged prostate has been commented on by several authors. Mulligan (1949) refers to diffuse hyperplasia of the prostate in 60 per cent of old dogs and he furthermore states that carcinoma in the dog is rare. According to Logan (1947) glandular hyperplasia in many dogs indicates that it is sometimes accompanied by cystic formation, with a varying decrease of the interstitial tissue response. Berg (1958) is of the opinion that a benign enlargement of the prostate gland, as a consequence of hormonal imbalance, occurs in about 50 per cent of adult dogs.

Of interest are the changes observed in the prostates of two dogs that were previously castrated: (i) in a nine-year-old Alsatian (P39) there was marked *hypertrophy of the fibromuscular tissue*, whereas in (ii) an aged Alsatian (P49) the prostate was smaller than normal, with prominence of the fibromuscular tissue, and atrophy of the glandular tissue. Zuckerman & McKeown (1938) record most pronounced involution of the prostate in two castrated dogs, in which the ratio of the fibromuscular tissue to the epithelial elements is much increased.

Adrenal

1. *Neoplasm*

A carcinoma of the adrenal was observed in a Boxer (P18), age not specified, with metastasis in the spleen and liver. The tumour was unilateral, encapsulated and about 6×10 cm. in size. It was greyish-white in colour and the consistence was fairly firm. It was more or less uniformly lobulated, and in the spleen and liver nodules from 0.5 to 2 cm. in size were observed. There was a great deal of anaplasia in the structure of the tumour, and only here and there was there evidence of the cortex. The cells throughout were very irregular and undifferentiated. Anderson indicates that metastasis readily occurs in case of carcinoma of the adrenal.

2. *Hyperplasia*

In 18 dogs (see Tables 1 and 3) *hyperplasia* of the cortex and/or of the medulla of the adrenal was observed. Their ages varied from five to 13 years. In the majority of cases the cortex was involved, and less frequently the medulla. In a few dogs there was hyperplasia of the cortex and medulla (P111 and P416). In case of the cortex it was usually nodular in appearance, and in some with atrophy of the medulla (P470). On the other hand there was also marked hyperplasia of the medulla with distortion of the cortex (P72 and P101). A difficulty was experienced in deciding whether a few of these hyperplasias were already of the nature of a neoplasia. In one case (P389) there was a suspicion of a chromaffin tumour of the medulla of both adrenals.

Cotchin (1954c) refers to a few neoplasms of the adrenal, and states that nodular hyperplasia of the cortex is a common finding in dogs. Nodular hyperplasia of the cortex, according to Mulligan (1948) is seen in 35 to 65 per cent of dogs, whereas true neoplasia is uncommon. Nieberle & Cohrs (1931) draw attention to the difficulty in differentiating between a nodular hyperplasia of the cortex and an adenoma, and they also refer to the infrequent occurrence of chromaffin tumours in dogs. Anderson (1953) in referring to diffuse or nodular hyperplasia of the adrenal cortex, also states that no sharp division can be drawn between nodular hyperplasia and a true adenoma.

Alimentary System

1. *Salivary gland neoplasms*

(i) A 13-year-old male Spaniel (P16) revealed a tumour affecting the parotid salivary gland. It was about 4 cm. in diameter with a nodular appearance and not encapsulated. There was a pleomorphism of the cells and an irregular stroma with a good deal of fibrosis. Metastasis was present in the regional lymph nodes, heart and lungs, and a *carcinoma* was diagnosed.

(ii) A ten-year-old Bull Dog (P379) showed a *carcinoma* of the mandibular salivary gland with metastasis in the lungs. It was the size of a large orange, not encapsulated, and of the nature of whorls of large epithelial cells, in an irregular stroma.

With reference to the above two tumours, it is interesting to note Willis's statement in connection with the pleomorphic nature of the adeno-carcinoma of salivary glands. Their structure according to him was very variable, usually not encapsulated, and widely infiltrated into the surrounding tissues, and occasionally with metastasis.

2. *Tongue*

A tumour on the tongue of a six-month-old Alsatian (P344) was surgically removed. It appeared to be of the nature of an *epidermoid carcinoma*, and in places with loss of recognisable epidermoid character.

3. *Mouth*

(i) A tumour from the upper jaw, premaxillary region, of a six-year-old Ridge-back (P471), appeared to be of the nature of a *fibrosarcoma*. The specimen was unfortunately badly selected.

(ii) The specimen of a tumour on the lower jaw of a Pug (P61), age not specified, was of the nature of a *fibroma*.

(iii) An eight-year-old Alsatian (P81), showed a *reticulum-cell sarcoma* on the lower jaw.

4. Stomach

The specimen of a tumour attached to the ventral aspect of the stomach of a ten-year-old Wire Haired Terrier (P220), was submitted for a diagnosis. This tumour had reappeared after it was previously surgically removed. It was about the size of a golf ball, nodular in appearance and firm. Imprint smears revealed amongst several cell types, clusters of spindle-shaped cells. The stained section showed whorls of spindle-shaped cells, as well as rows of cartilage cells and a few areas of necrosis. It was diagnosed as a *fibrosarcoma*, in which there was the presence of cartilage cells.

According to Muir (1941) the formation of bone and cartilage may occur by a process of metaplasia in sarcomata of soft tissues.

5. Liver

A. *Neoplasms in the liver.*—(i) A *carcinoma* of the liver was diagnosed in a 12-year-old Crossbred (P28). It was of the nature of a large tumour mass in the posterior aspect of the right lobe of the liver. It was lobulated and nodular in appearance, and friable. The stained section showed an irregular distribution of pleomorphic cells, some with fatty changes.

(ii) A specimen of a liver of a Fox Terrier (P34), age not specified, showed multiple light brown nodules, about 1 to 2 cm. in diameter, friable and not well circumscribed. The section revealed liver lobules that were markedly disorganised by the integration of the tumour cells, which were irregularly spherical to oblong in shape, with fatty changes. There was a round cell infiltration in the interstitium. A *liver-cell carcinoma* was finally diagnosed.

It is interesting to note that Willis refers to liver-cell anaplastic growths with great cellular pleomorphism, much degeneration and haemorrhage. Nieberle & Cohrs indicate that liver carcinoma is infrequent in the dog, but apparently more frequent than in the European and furthermore metastasis is not as frequent as in man.

(iii) In an 11-year-old Ridgeback (P84) haemangioma-like lesions were observed in the liver, spleen and in a pedunculated nodule on the prostate. Were these of the nature of an *angiosarcoma* or *multiple hamartomas*?

Willis indicates that it is not unusual that multiple vascular hamartomas are present in several organs, such as the liver and spleen, or the liver and lungs. These multiple foci may resemble a metastasis.

(iv) The lesions observed in the liver of a 12-year-old Wire Haired Terrier (P157) was more of the nature of an *angiosarcoma* than multiple cavernous haemangiomas. Irregular spaces and caverni filled with blood caused much irregularity of the lobules of the liver, as a result of its invasive nature.

Metastasis in the liver.—The following primary neoplasms revealed metastasis in the liver: (i) chondrosarcoma of the humerus (P26); (ii) and (iii) two cases of reticulum-cell sarcoma of the spleen (P40 and P389); (iv) reticulum-cell sarcoma of the ovary (P21); (v) carcinoma of the kidney (P255).

B. *Hyperplasia of the liver.*—Six cases of hyperplasia of the liver were observed in dogs with ages varying from eight to 13 years (P36, P64, P74, P108, P111 and P470). The lesions were usually of a nodular appearance, and of a lighter colour than the rest of the liver. In some cases these nodules comprised several hypertrophied lobules with large vacuolated cells (P36). These nodules were irregular in outline, often made up of irregular columns of liver cells (P108). In all these cases there was no evidence of an increase in the connective tissue and the sinusoids were usually not apparent.

In some instances it was difficult to decide whether some of these lesions were on the borderline of a benign neoplasm (P470). Nieberle & Cohrs indicate that often a sharp differentiation between nodular hyperplasia and an adenoma in the liver is not possible. Hyperplasia of the liver cells according to Mulligan (1949) is fairly common in the dog (in ten out of 61 dogs autopsied), whereas true neoplasms are relatively unusual. He states that the interlocking cords of cells varied from a single to many cells thick to large solid masses, without intervening sinusoids.

6. *Pancreas*

(1) *Neoplasm*.—A small circumscribed non-encapsulated nodule was observed in the pancreas of a 12-year-old Scottie (P111). It was diagnosed as an *adenoma*, and it was well-differentiated from the rest of the pancreas. The cells in the form of interlocking columns were stained a light pink throughout with the H.E. stain, in contrast to the cells of the normal acini.

The occurrence of carcinoma in the pancreas of dogs was referred to by several authors.

(2) In a few aged dogs (P108, P158, P264 and P416) interesting changes were observed in the pancreas. In these cases some of the lobules of the pancreas showed a disintegration of the acini, which were distorted, broken down in places and irregular in outline. Many of the cells of the acini were free, irregular in shape, and some without nuclei, without any increase in the connective tissue stroma. These changes were not considered to be of the nature of a neoplasia, neither did they resemble regressive or postmortal changes. Further studies seem to be indicated when material becomes available.

7. *Intestines*

(i) Specimens of the ileum and caecum of a spayed three-year-old Fox Terrier (P5) were of the nature of a *carcinoma*. The mucous membrane had an irregular nodular appearance, with marked invasive growth through the muscularis mucosae, and fairly extensive thickening of the submucosa.

(ii) A 15-year-old male Wire Haired Terrier (P64), showed an *adenoma* of the mucous membrane of the caecum.

(iii) A 13-year-old female Fox Terrier (P187), revealed at the junction of the rectum and anus three small tumours with ulcers. There was extensive infiltration of the mucosa and submucosa with cells of the nature of epithelial cells. In view of their pseudo-alveolar-like arrangement, one was therefore inclined to regard these tumours as of the nature of *transmissible venereal neoplasms*.

Urinary System

1. *Kidney*

Neoplasms.—(i) The right kidney of an eight-year-old Scottie (P252) revealed a *carcinoma*. It was about the size of a cricket ball and nodular, with fairly extensive metastasis in the liver.

(ii) The *carcinoma* in the right kidney of a seven-year-old male Ridgeback (P42) was about the size of an ostrich egg, nodular in places, with multiple haemorrhages. It was soft and friable and on one side only a small piece of the much atrophied

kidney tissue was visible. The section showed clusters of spindle-shaped cells, almost resembling a sarcoma. Willis, however, indicates that carcinoma of the kidney is made up of anaplastic variants, spindle cells or pleomorphic cells, which has led to an erroneous diagnosis of sarcomatosis. In this case the left kidney revealed lesions of an interstitial nephritis.

Metastasis.—Of interest was the occurrence of metastasis in the kidneys of two dogs: (i) chondrosarcoma (P336), and (ii) osteosarcoma (P470).

2. Bladder

In the bladder of an 11-year-old Scottie (P388) lesions of a *fibro-epithelioma* were diagnosed. As pointed out above this Scottie also showed lesions of a lymphosarcoma in the lymph nodes, spleen and mesentery.

Cardiac System

1. Neoplasia

A laparotomy on a male Bull Terrier, age not specified (P416), revealed ascites and a marked congestion of the organs, especially of the liver and kidneys. The dog was destroyed, and only the viscera were submitted for an examination.

The epicardium was irregularly thickened, greyish-white in colour, with a few protruding nodules. A row of greyish-white nodules, about the size of a pea, were also observed on the serosa of the colon, where the mesentery was attached. In both cases the lesions were confined to the serosa and the underlying tissues were not penetrated.

The sections of the epicardium showed circular whorls of spindle-shaped cells and fibrils with a mesh of similar tissue in the centre. It almost resembled a reticulum-cell sarcoma, except for the presence of large epithelioid free cells here and there.

The nodules on the colon were composed of smaller nodules lying within a connective tissue capsule. These smaller nodules comprised a network of stellate cells, in places arranged almost like a rosette.

Both the cortex, and especially the medulla of the adrenal showed what appeared to be well-marked hyperplasia.

The lesions on the epicardium and colon were considered to be of the nature of a *neuroblastoma*. At present it is difficult to say to what extent the medulla of the adrenal was also involved. The epithelioid cells observed in the subepicardial mesenchyme bear some resemblance to the cells referred to by Jackson (1936) in his discussion on the heart base tumours of dogs. In his opinion there is a likelihood that these heart base tumours are actually neuroblastomas. According to Cotchin (1959) heart base tumours are believed by some to be derived from the aortic bodies. Willis maintains that the medulla of the adrenal, the coeliac and mesenteric ganglia, as well as the cervical and thoracic parts of the sympathetic chains, account for the majority of cases of neuroblastomatosis.

2. Metastasis

Metastasis in the heart was observed in two primary neoplasms: (i) carcinoma of the parotid salivary gland (P16) and (ii) osteosarcoma of the right stifle joint (P470).

*The Respiratory System*1. *Nose*

(i) A one-year-old Boxer (P23) showed a tumour on the left side of the face, below the eyelid, where it was firmly adherent to the bone. The medial section of the skull on the left side revealed a tumour mass, in which the ethmoid, turbinates and underlying bones of the face were involved. It was of the nature of whorls of spindle-shaped cells, which in places dominated the picture. In the stroma there were clusters of cells, varying from spherical to polyhedral in shape, with an alveolar-like arrangement. In this tumour there appeared to be a proliferation of connective tissue and epithelial types of cells, and it was considered to be of the nature of a *carcinosarcoma* of the ethmoid, with extension through the bones on to the face.

(ii) In a six-year-old female Gorgi (P494) the ethmoid bone was markedly disfigured by a tumour mass, about the size of a hen's egg. It had penetrated through the nasal bones to reach the skin on the right side of the nose. Here it showed a swelling about 1 cm. in diameter, with a small ulcer superficially. The tumour comprised an irregular matrix of connective tissue, with remnants of cartilage and bone, and what appeared to be proliferation of the glands of the corium of the mucous membrane. This tumour was also diagnosed as a *carcinosarcoma*.

The respiratory system tumours are not common in the dog according to Cotchin (1959), and those that do occur chiefly affect the nasal bones. Willis states that the real existence of an occasional *carcinosarcoma* is stronger in animal than in human pathology. Jackson (1936) refers to the occurrence of a transitional-cell carcinoma in close proximity of the ethmoid bone, and he is of opinion that the presence of the rapidly proliferating fibroblasts is to be interpreted as a secondary manifestation, and not as a mixed tumour. Tumours arising from the ethmoid bone, according to him, undergo an invasive spread into the nasal chamber, maxillary and frontal sinuses, and orbit.

(iii) A specimen of a 12-year-old dog (P506), was submitted for a diagnosis. The nasal cavity was markedly involved, as well as the maxillary bones and their sinuses. They were infiltrated with a greyish-white firm and fibrous tumour. Some of the teeth of the lower jaw were missing, and the jaw was also affected, but its mucous membrane was intact. On the left side, the nasal cavity was completely obstructed posteriorly. This tumour was definitely of the nature of a *squamous epithelioma*.

The three neoplasms considered above should receive further attention when more specimens become available.

2. *Lung*

No primary lung neoplasms in dogs were observed at the Liesbeek Cancer Clinic. Metastasis was, however, recorded in the following primary tumours: (i) carcinoma of the parotid salivary gland (P16); and in three cases [(ii), (iii) and (iv)] the lungs of the dogs (P26, P36 and P336) showed secondary lesions of a *chondrosarcoma*.

Primary neoplasms of the lung are according to Cotchin (1954c) very rare in dogs. Ten Thije & Ressang (1956) refer to an increase in the incidence of primary lung tumours in dogs investigated at the Veterinary School at Utrecht. In a total of 9,784 autopsies from 1924 to 1954, there were 22 cases of primary lung cancer, of which 16 occurred during the last four years. On the other hand no increase of

pulmonary carcinoma could be established in recent years at the Veterinary Pathological Institute at Zurich (Excerpta Medica, Cancer, page 74, volume 8, section XVI, 196). The infrequency of lung cancers in dogs in London may, according to Cotchin (1959), be due to the fact that they do not live long enough for any carcinogenic action by the polluted air they breathe. There was in London no indication of an increase of primary lung tumours in dogs.

This aspect of lung cancer in dogs would appear to be of considerable comparative value to man, and deserves a more widespread investigation.

Male Genital Organs

1. *Testis*

A large number of papers on tumours of the testes of dogs has been published overseas. The diagnosis of some of these tumours examined at the Liesbeek Cancer Clinic gave rise to difficulties, particularly in those where the cells of the lesions revealed a great deal of anaplasia. Some of these will be re-examined as soon as more material becomes available. Seminoma, Sertoli-cell or interstitial-cell neoplasms were observed in a number of dogs (P16, P36, P68, P84, P101, P162, P163, P167, P222 and P262). In some only one testicle was affected, whereas in others both were involved, and the ages of these dogs varied from eight to 13 years. Some of the tumours were only identified when the testis was sectioned. In the majority of cases there was a good deal of invasion of the organ, with anaplasia of the cellular structure and fibrosis.

Mulligan (1948) maintains that the greater portion of old dogs displays nodular hyperplasia of the spermatogonia, sustentacular cells and of the interstitial cells, which show gradual dedifferentiation through nodular hyperplasia to full-blown neoplasia. Nieberle & Cohrs (1931) are also of opinion that the tumours in old dogs are more of the nature of a nodular hyperplasia.

In two dogs fairly large *Sertoli-cell tumours* were observed in *undescended testes*. The descended testes were affected to a slight extent.

(i) In a healthy mongrel, age not specified, used for lymph tapping, the undescended testis was about the size of a large orange. It showed a lobulated and nodular appearance, with fairly marked fibrosis. The testis in the scrotum was more or less of normal size, and it had attached to it both the epididymides.

(ii) The undescended testis in an eight-year-old Maltese Terrier (P222) was about the size of a hen's egg, with fairly extensive fibrosis. The descended testis also showed the presence of a Sertoli-cell neoplasm.

Scully & Coffin (1952) indicate that about 5 per cent of canine testicular tumours occurred in undescended testes, whereas Cotchin (1956) states that eight out of 33 Sertoli-cell neoplasms were observed in cryptorchids.

2. *Penis*

Transmissible venereal tumours of the penis were identified in the following dogs:—

(i) An Alsatian (P86), age not specified.

(ii) The specimen of a tumour from a three-year-old Great Dane was situated around the middle of the penis, and had the appearance of a small cauliflower.

It is interesting to note that Cotchin (1959) refers to ten specimens of the penis of dogs affected with transmissible venereal tumours.

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3. Bladder

A tumour of the nature of a *fibro-epithelioma* was observed in the bladder of an 11-year-old Scottie (P388).

Female Genital Organs

1. Ovary

A 15-year-old mongrel (P21), revealed a *reticulum-cell sarcoma* in the ovary with metastases in the liver, spleen and lung.

2. Vagina

(a) *Transmissible venereal tumours* were diagnosed in the vagina of two dogs:—

- (i) A one-and-a-half-year-old Bull Dog (P174); and
- (ii) A six-month-old Collie (P472). In this case the tumour was of the nature of a pedunculated growth, with fibrosis, haemorrhage and ulceration.

Cotchin (1954b) also refers to the occurrence of such tumours in the vagina of dogs.

(b) In a nine-year-old Collie (P166) a *fibra-sarcoma* of the vagina was diagnosed.

3. Uterus

An eight-year-old Scottie (P74) showed a tumour about the size of an ostrich egg in the uterus, and a diagnosis of a *leiomyosarcoma* was made.

4. Mammary gland

The following tumours were observed in the mammary glands of dogs:—

- (i) Two-year-old Poodle (P271): *fibroma*.
- (ii) Eleven-year-old Toy Pom (P171): *fibro-epithelioma*.
- (iii) Nine-year-old Dobermann (P2): *fibroma*.
- (iv) Ten-year-old Dachshund (P110): *papilliform cyst-adenoma*.
- (v) Eleven-year-old Alsatian (P225): *papilliform cyst-adenoma*.
- (vi) Seven-year-old Dachshund (P456): *fibro-sarcoma*.
- (vii) Eight-year-old Dachshund (P259): *carcinosarcoma*.

5. Teat

A ten-year-old Irish Setter (P470) revealed a *fibro-epithelioma* on the teat.

Skeleton

The following bone tumours were examined in dogs:—

- (i) A 13-year-old Setter (P26), showed a *chondrosarcoma* on the dorsal aspect of the humerus, with metastases in the liver and lung. The tumour was about the size of an ostrich egg and had integrated into the bone.
- (ii) The left mandibular bone of an aged Dobermann (P36), revealed a *chondrosarcoma* with metastasis in the lung.

- (iii) On the right side of the proximal part of the humerus of a nine-year-old Alsatian (P39) a *chondrosarcoma* was diagnosed.
- (iv) A nine-year old Great Dane (P196) showed a *chondrosarcoma* in the right hip joint with metastasis in the lung. It was firm and about the size of a large orange.
- (v) There was a *chondrosarcoma* in the left shoulder joint of a five-year-old Ridgeback (P336). Besides metastasis in the lung, it was interesting to note that secondary lesions were also present in the kidney.
- (vi) An *osteosarcoma* was observed in the left carpal joint of a six-year-old Great Dane (P236).
- (vii) A ten-year-old Irish Setter (P470) showed an *osteosarcoma* in the right shoulder joint, with metastases in the myocardium, spleen and kidney.
- (viii) A specimen of the hock of a dog (P505) was submitted with no particulars. It was of the nature of a *fibro-sarcoma*.

Of interest in these cases is the fact that these tumours were observed in the larger breeds of dogs and mainly in the proximal part of the long bones. Cotchin (1954a) records that nearly all bone tumours in dogs are malignant, and that the large breeds (as above) are mostly affected, and particularly the upper part of the humerus. It will be of interest to know to what extent traumatic influences played a part in the causation of these neoplasms.

Cutaneous Tumours

1. *Peri-anal region*

(i) A 12-year-old Fox Terrier (P7) revealed an *adenoma*.

(ii) A *carcinoma* was diagnosed in the peri-anal region of a 12-year-old Dobermann (P3), with metastases in the regional lymph nodes (sacral).

(iii) A peri-anal *adenoma* was diagnosed in a specimen of a dog (P152) with no particulars submitted.

Jackson (1936) investigating what he called the adenoid epithelioma of the peri-anal region of dogs, indicates that the skin of these animals provides excellent material for studying the cutaneous neoplasms, especially in various glands of the skin. Nieberle & Cohrs (1931) refer to the presence of single or multiple adenoma in the anal region of dogs up to the size of a hen's egg. They are derived from the anal glands of the corium, and many may become malignant with metastasis. Cotchin (1959) maintains, however, that they rarely show metastasis, and that these tumours arise from the circumanal and other modified sebaceous glands. They occur almost exclusively in old male dogs, and they may be multiple, and show ulceration and haemorrhage.

2. *Prepuce*

The following tumours were observed in the prepuce of three dogs:—

(i) A *basal-cell epithelioma* with ulceration was observed in a seven-year-old Bull Terrier (P1).

(ii) The specimen of the prepuce of an 11-year-old Bull Terrier (P121) showed a *squamous epithelioma* with ulceration.

(iii) A *squamous epithelioma* with proliferation of the hair follicles was also diagnosed in the specimen of the prepuce of a Bull Terrier (P378), age not specified. Metastasis was observed in the regional lymph nodes.

In respect of the above tumours the classification of Muir (1941) and Jackson (1936) was respectively adopted, viz. squamous epithelioma for squamous carcinoma, and basal-cell epithelioma for basal-cell carcinoma.

3. *Other cutaneous neoplasms investigated*

(i) A *reticulum-cell sarcoma* was diagnosed in the skin of the toe of a three-year-old Spaniel (P17). It revealed metastases in a number of lymph nodes.

(ii) A neoplasm attached to the wing of the Atlas of a 13-year-old Cross Bred (P162) was of the nature of a *giant-cell sarcoma*.

(iii) A 16-year-old male Scottie (P264) showed a fairly large tumour on the head. It extended from the region of the Atlas, around the base of both ears to the front of the eyes, which it surrounded, without interfering with the eyesight. The size of the tumour was about $4 \times 6 \times 8$ inches, and the surface of the skin was very irregular and nodular. The dog was apparently in good health, and it was stated that it was injured in a motor car accident about a year ago.

At first it was thought that the tumour was of the nature of a fibro-sarcoma, but in some of the sections examined, remnants of nerve fibres were identified. The cells around them showed extensive proliferation. A final diagnosis of a *neurogenic sarcoma* was made.

(iv) A 14-year-old cross bred male Fox Terrier (P301), revealed a tumour about 2 cm. in diameter on the medial aspect of the abdomen. It was fairly well circumscribed and raised above the surface of the skin with a small ulcer. A fibro-sarcoma was suspected, but the examination of some of the sections revealed lesions which were of the nature of a *capillary haemangioma*. It showed long thin spindle-shaped cells, enclosing small oblong spaces filled with blood. In places there were a few small clusters of cells, probably of the nature of endothelials, associated with the formation of the vascular capillaries, which formed the basis of the neoplasm.

(v) A tumour about the size of an ostrich egg was observed in an aged Airdale (P33) in the region of the right shoulder joint, along the upper part of the humerus. It was circumscribed, firm and greyish-white in colour. The imprint smears of the tumour showed a large number of long, slender, spindle-shaped cells. In the section examined, there was a connective tissue stroma, and here and there a conglomeration of anastomosing congested capillaries. In places there was also a proliferation of what appeared to be endothelials. Like the tumour above, it was diagnosed as a *capillary haemangioma*.

Mulligan (1955) states that the constant association of neoplastic capillaries and pericytes was the most important characteristic of the haemangiopericytoma. He mentions the packing of pericytes around relatively closely set capillaries. Cotchin (1959) also refers to the occurrence of such tumours in the subcutis of older dogs. In the two cases at the Liesbeek Clinic, and referred to above [(iv) and (v)], the proliferating pericytes around the capillaries were, however, not observed.

(vi) The specimen of a tumour from a ten-year-old Dachshund (P260), was situated in the shoulder region. It was about the size of a plum. In view of the pseudo-alveolar arrangement of the polyhedral-shaped cells, a diagnosis of a *transmissible venereal tumour* was made.

(vii) The specimen of a tumour situated on the skin of the front leg of a one-and-a-half-year-old Boxer (P89), revealed lesions of a *transmissible venereal tumour*.

Transmissible Venereal Tumours of Dogs

These tumours were observed in the skin, penis, vagina and rectum-anus of dogs examined at the Liesbeek Clinic. Four cases occurred in dogs aged from six months to three years.

Jackson (1936) records the following incidence amongst 72 cases at Onderstepoort: skin, four; penis, sheath and scrotum, seven; and vagina, two. He maintains that these tumours occur with considerably greater frequency than is generally recognised in the superficial parts of the body, quite remote from the genitalia. He refers to the transmission of these tumours by actual grafting of neoplastic cells from individual to individual by direct contact, and to the baffling attempt at a satisfactory classification microscopically. Bloom *et al.* (1951) indicate that these tumour cells are end cells of reticulo-endothelial origin. The present author is inclined to agree with Jackson, who is in favour of its carcinomatous nature, on account of the alveolar-like distribution of the closely packed polyhedral cells, with the absence of interlobular fibrils.

CONCLUSIONS

In respect of several tumours of dogs referred to above, important issues were raised, which need further clarification.

It would undoubtedly be of great comparative value if the aetiology and the multicentric development of lymphosarcoma of dogs could be solved. The problem of the endocrine imbalance associated with certain tumours of the testes of dogs should receive further consideration. It would be interesting to ascertain why the long bones, especially of the larger breeds of dogs, are so often affected with neoplasms of the bone.

Were the report of the less frequent occurrence of neoplasms of the viscera of dogs (e.g. stomach, intestines, etc.), when compared to that of man, probably due to the fact that animals affected with these tumours, are not so regularly submitted for an examination as those with visible tumours?

In several instances the classification of these neoplasms raised difficulties. Were some of the cutaneous tumours described above, of the nature of so-called carcinosarcoma, or were they transitional-cell carcinoma referred to by Jackson?

At certain stages it was difficult to state whether some of the suspected hyperplasias in such organs as the liver, prostate, spleen and adrenal were of the nature of a benign neoplasm.

As indicated above the tumours of the vascular system gave rise to difficulties in arriving at a diagnosis, especially in deciding whether some of them were either a hamartome or a neoplasm, and whether the neoplasms were haemangioma or angiosarcoma.

It will also be helpful if agreement could be reached in respect of the microscopical classification of the so-called transmissible venereal tumours of dogs.

Difficulties encountered in respect of the diagnosis of tumours were emphasized by Cotchin (1959), and the need of a pathological atlas was stressed by him, or a method which would afford much greater standardisation of tumour classification.

The proposals of inaugurating such a tumour registry in various countries will greatly assist in the study of neoplasms. There is no doubt that, according to Cotchin, a better statistical precision would assist in problems relating to the aetiology of tumours, their incidence and biological behaviour in different species and breeds of animals. Valuable information gained in this way will undoubtedly be of great comparative value, particularly in respect of cancer in man.

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