Bull. Org. mond. Santé
Bull. Wld Hlth Org. } 1974, **50**, 79-100

VII. Tumours of the skin*

E. WEISS [1] & K. FRESE [2]

Tumours occur more frequently in the skin than in any other part of the body. Epithelial tumours are described under the following headings: basal cell tumour, squamous cell carcinoma, papilloma, sebaceous gland tumour, tumour of hepatoid glands, sweat gland tumour, mixed tumour of apocrine sweat glands, carcinoma of apocrine sweat glands, tumour of hair follicle, and intracutaneous cornifying epithelioma. Tumours of the melanogenic system are divided into benign melanoma and malignant melanoma, the latter being subdivided into the following types: epithelioid, spindle cell, epithelioid and spindle cell, dendritic, and whorled.

A classification of skin tumours of domestic mammals is not only of scientific but also of practical value. Tumours of the skin occur more frequently and are more often removed surgically than other tumours are. A classification that can be based only on histological typing raises great problems. The first difficulty is that the skin is composed of various structures, such as the epidermis, hair follicles, sebaceous and sweat glands of different types, and soft tissue components of the corium and subcutis, all of which can be the origin of neoplastic growth or be otherwise involved. The second difficulty is that veterinary medicine deals with not one but several species. Differences between species in the formation and function of skin are of great importance and are not fully understood, especially as regards the ultrastructure and physiology.

Despite these difficulties, the authors believe, in the light of their experience of more than 9 000 skin tumours (mostly of dogs), that a workable classification related as far as possible to similar conditions in man is feasible. They are fully aware that such a classification cannot meet all requirements and cannot be final. It reflects the present state of knowledge and should promote a better understanding among pathologists using various nomenclatures, synonyms, and classifications.

It is not the purpose of the classification to replace textbooks of general or special tumour pathology or publications in which particular tumours are described in detail. The classification should help those less experienced in diagnostic or research work to find their way. For experienced pathologists, especially those engaged in teaching, the classification provides a framework for diagnostic work and training programmes.

Besides true neoplastic tumours, tumour-like lesions have also been listed in the classification, since they are important in differential diagnosis. Furthermore, the biological behaviour of skin tumours has been mentioned wherever possible. Knowledge on this point is incomplete because, for many tumours, especially melanomas, adequate follow-up studies have not been carried out, and the histological picture alone is often insufficient for a reliable prognosis of the behaviour of tumours. For example, basal cell tumours in dogs often look malignant histologically, yet they are nearly always benign.

Owing to lack of space, not all the tumours listed in the classification could be illustrated with figures. An attempt has been made to give the essential information on the more common tumours and on rare tumours of special comparative or scientific interest. In making comparisons with skin tumours of man particular attention has been paid to any analogies or differences.

Clinical information, which is often inadequate in veterinary oncology, is included only if essential for the classification of a certain tumour.

DIAGNOSTIC PROCEDURES

For diagnostic purposes as much material as possible should be submitted, preferably the whole tumour. A careful description of the macroscopic

* From the Veterinär-Pathologisches Institut, Justus Liebig-Universität, Frankfurterstrasse 96, 6300 Giessen, Federal Republic of Germany.

[1] Director.

[2] Professor.

appearance of the lesion is of great help to the histopathologist. Needle biopsies are less suitable and can easily lead to a wrong diagnosis. Only in more-or-less uniform tumours, such as mast cell tumours or histiocytomas, are small incisional biopsies acceptable, though not recommended.

The tissues should be properly fixed immediately after removal. The usual formalin fixation gives good results and is cheap and convenient. Thin paraffin sections stained with haematoxylin and eosin are in most cases sufficient for diagnosis. Frozen sections are less satisfactory, although they are indicated for the application of certain histochemical methods and for quick diagnosis. Special stains, such as van Gieson's, Gomori's, and periodic acid–Schiff may be necessary to distinguish certain tumours. Metachromatic stains, e.g., toluidine blue, should be used to recognize mast cell tumours. Masson–Fontana staining is helpful for diagnosing unpigmented or poorly pigmented melanomas. Sections of highly pigmented melanomas should always be bleached before staining.

HISTOLOGICAL CLASSIFICATION AND NOMENCLATURE OF TUMOURS OF THE SKIN

I. EPITHELIAL TUMOURS AND TUMOUR-LIKE LESIONS

A. Basal cell tumour (basal cell carcinoma)

B. Squamous cell carcinoma

C. Papilloma
1. Squamous cell papilloma
2. Fibropapilloma

D. Sebaceous gland tumour
1. Sebaceous adenoma
2. Sebaceous carcinoma
3. Tumour-like hyperplasia

E. Tumour of hepatoid (perianal) glands
1. Adenoma of hepatoid glands
2. Carcinoma of hepatoid glands
3. Tumour-like hyperplasia

F. Sweat gland tumour
1. Papillary syringadenoma
2. Cystadenoma of apocrine sweat glands
3. Spiradenoma
4. Mixed tumour of apocrine sweat glands
5. Carcinoma of apocrine sweat glands
   (*a*) Papillary carcinoma
   (*b*) Tubular carcinoma
   (*c*) Solid carcinoma
   (*d*) Signet-ring-cell carcinoma

G. Tumour of hair follicle
1. Trichoepithelioma
2. Necrotizing and calcifying epithelioma (Malherbe)

H. Intracutaneous cornifying epithelioma ("keratoacanthoma")

I. Cysts
1. Epidermal cyst
2. Dermoid cyst
3. Follicular cyst
4. Cyst with epithelial proliferation

II. TUMOURS OF THE MELANOGENIC SYSTEM

A. Benign melanoma
1. Benign melanoma with junctional activity
2. Benign dermal melanoma
   (*a*) Cellular type
   (*b*) Fibromatous type

B. Malignant melanoma
1. Epithelioid type
2. Spindle cell type
3. Epithelioid and spindle cell type
4. Dendritic and whorled type

III. TUMOURS OF SOFT (MESENCHYMAL) TISSUES

IV. SECONDARY TUMOURS

V. UNCLASSIFIED TUMOURS

DESCRIPTION OF TUMOURS

I. EPITHELIAL TUMOURS AND TUMOUR-LIKE LESIONS

A. *Basal cell tumour (basal cell carcinoma, basalioma, basal cell epithelioma)* (Fig. 1–4)

These are fairly well demarcated and in general benign tumours in which the peripheral palisaded cells resemble basal cells of the epidermis. They show a great variety of histological patterns. Solid, garland- or ribbon-like, medusoid, adenoid, cystic, and basosquamous varieties, sometimes with foci of keratinization, occur singly or in combination. Therefore, if subdivision is necessary, it should be based on the predominant histological pattern. Mitotic figures and melanin pigmentation are frequently encountered in basal cell tumours. Despite their often anaplastic appearance histologically, basal cell tumours rarely metastasize or recur after excision. Only the locally invasive basosquamous variety seems to be more aggressive, but present knowledge does not justify a more definite statement.

The tumours are thought to arise from basal cells of the epidermis, but a naevoid histogenesis has also been suggested. The histology of basal cell tumours of domestic mammals is similar to that of basal cell carcinoma in man. Superficial multicentric, morphoea, and fibroepithelial types, important in man, have not been shown to occur in animals.

Basal cell tumours are common in dogs and cats, but rare in other species. They are located mainly on the head and neck, but can occur anywhere on the body. Large tumours are often superficially ulcerated.

B. *Squamous cell carcinoma (epidermoid carcinoma)* (Fig. 5–7)

This is an invasive malignant epidermoid tumour of varying cellular differentiation. The well-differentiated type is composed of squamous cells arranged in cords or whorls with keratinized centres, often in the form of lamellated pearls. Keratinization of single cells occurs. Intercellular bridges are easy to find and are useful in distinguishing squamous cell carcinoma from basal cell tumours. Inflammatory processes, especially in the periphery of the tumour, are common. In less well differentiated types, keratinization of single cells is more frequent but pearls and intercellular bridges are less common. In poorly differentiated tumours, it is often difficult to recognize the tumour cells as squamous cells. Keratinization, when present at all, is restricted to single cells and is usually connected with karyorrhexis and not pyknosis as in better differentiated types. In rare cases, most of the tumour cells are spindle-shaped (spindle cell type) and can easily be confused with those of sarcomas or carcinosarcomas. Mitotic figures are common in all types of squamous cell carcinoma, but are more frequent and more atypical in the poorly differentiated tumours.

Squamous cell carcinomas of the skin occur relatively frequently in all species except the pig, and can arise on any part of the body. They are moderately malignant and certainly less so than their counterparts at mucocutaneous junctions or in other organs. An exception is the common, usually ulcerated, squamous cell carcinoma of the toes in dogs, which has a greater tendency to metastasize into the regional lymph nodes.

In man, precancerous lesions, such as actinic (solar) keratosis, Bowen's disease, arsenical keratosis, radiation dermatosis, and xeroderma pigmentosum (congenital), play an important role in the development of squamous cell carcinomas. In animals, these early changes have usually not been reported, which is not to say that they do not occur. Solar radiation is an etiological factor in squamous cell carcinoma in the ears and nose of white cats, on the perineum and ears of Angora goats in Africa, and on the eyelids of cattle (" cancer eye "). Mechanical irritations and injuries (earmarks, grass seed infestations in certain strains of merino sheep, horncore cancer in Asian cattle) and burns (" brand cancer ") can also lead to squamous cell carcinoma.

C. *Papilloma (infectious wart)*

1. *Squamous cell papilloma* (Fig. 8). This virus-induced benign tumour may be pedunculated or sessile. The epithelium of the tumour is continuous with the normal epidermis and may be pigmented. The branching fingers of stroma (composed of connective tissue and blood vessels) and rete pegs of epithelium from the tumour, may dip into the stroma. The presence of basophilic intranuclear inclusion bodies in cells showing ballooning degeneration and varying degrees of keratinization may reflect the life history of the tumour.

2. *Fibropapilloma* (Fig. 9). In these benign virus-induced tumours of the ox, proliferation of fibrous tissue is as great as, or greater than, that of epithelial tissue. The lesions are usually larger than in the case of squamous cell papilloma. The fibrous tissue component forms whorls of fibres and has plump, stippled nuclei with few mitotic figures. The epithelial rete pegs often penetrate deep into the fibrous moiety.

D. *Sebaceous gland tumour*

Sebaceous gland tumours are most frequently encountered on the head (especially the eyelids and ceruminous glands of the ears) and extremities.

1. *Sebaceous adenoma* (Fig. 10). This benign tumour is composed predominantly of actively mitotic generative cells of sebaceous glands. Single cells show lipid vacuoles representing the start of differentiation. The tumour is very common in dogs, but rare in other species.

2. *Sebaceous carcinoma* (Fig. 11, 12). In this tumour undifferentiated polymorphous cells predominate. Maturing cells, which are rare, show a significantly different size of lipid vacuoles. The tumour looks malignant, but there is little information about its biological behaviour. It is rare in all species.

3. *Tumour-like hyperplasia (senile hyperplasia)* (Fig. 13). The lesion is often multiple and is characterized by the accumulation of proliferated, almost mature sebaceous glands. It is very common in old dogs, especially males.

E. *Tumour of hepatoid (perianal) glands*

Hepatoid glands are merocrine and are present in all dogs, especially in the perianal region (perianal or circumanal glands), but also on the prepuce, vulva, tail, hind limbs, and trunk. It is important to mention that in the perianal region there are also apocrine sweat and sebaceous glands, especially around the anal sac. Therefore not every glandular tumour in the perianal region necessarily arises from the hepatoid gland. Tumours of hepatoid glands occur mainly in old dogs and are by far more common in males.

1. *Adenoma of hepatoid glands* (Fig. 14, 15). These benign tumours can be subdivided into adenomas with secondary vascularization and adenomas with transitional cell forms, the latter being more common. The former are characterized by large glandular areas with small vessels and islands of soft tissue surrounded by reserve cells. Adenomas with transitional cell forms show, besides the structures already mentioned, cells with large, pale nuclei and narrow cytoplasmic edges. In our experience, recurrence is more frequent with the first subtype.

2. *Carcinoma of hepatoid glands* (Fig. 16). These malignant tumours are characterized mainly by great proliferation of reserve cells and the appearance of so-called " bird's eye " cells. Metastasis and recurrence after excision are common.

3. *Tumour-like hyperplasia* (Fig. 17). These benign lesions closely resemble normal hepatoid glands. Apart from the perianal region, they are to be found more often on the tail than other hepatoid gland tumours are.

F. *Sweat gland tumour*

Tumours of sweat glands are far less common than sebaceous gland tumours. They occur mainly in dogs, occasionally in cats, and rarely in other species. Tumours corresponding to human papillary hidradenoma, eccrine acrospiroma (clear cell hidradenoma), eccrine dermal cylindroma, syringoma, and hydrocystoma have not yet been described in animals.

1. *Papillary syringadenoma* (Fig. 18). This benign tumour is said to be derived from ducts of sweat glands. Coarse, branched processes covered with a double layer of epithelium project into cystic cavities. Accumulations of plasma cells are regularly found in the stroma.

2. *Cystadenoma of apocrine sweat glands* (Fig. 19). In the papillary subtype of this benign tumour, processes lined by a single layer of epithelium project into cysts partly filled with products of secretion. In a special variant, a wide, irregular net lined with a single layer of epithelium is to be found. Macrophages, which are regularly found in stroma and lumina of cysts, often contain ceroid.

3. *Spiradenoma* (Fig. 20, 21). This benign tumour is composed of two types of cell: cells with small dark nuclei and secretory cells with large and pale nuclei. The cells may be diffuse and irregularly arranged or may form a glandular pattern. The tumour, which greatly resembles its human counterpart, is said to originate in the secretory part of eccrine sweat glands. It is not known if the tumour is as painful in dogs as it is in man.

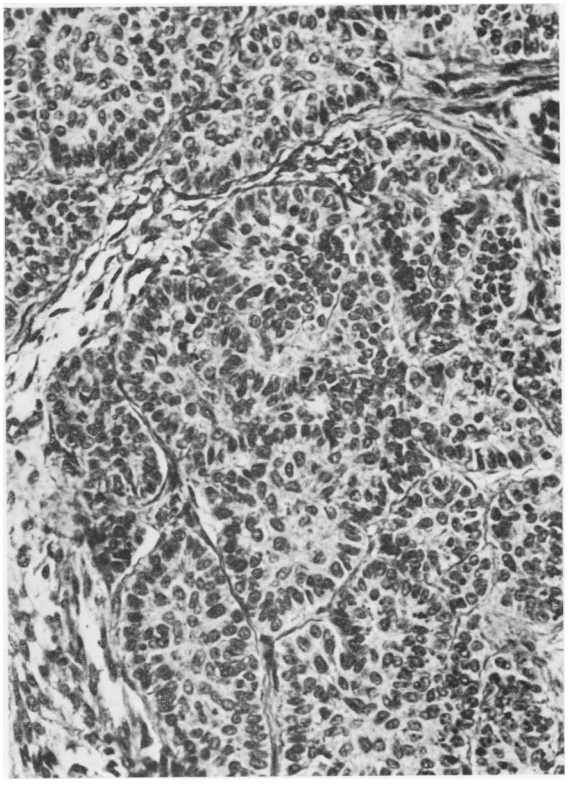

Fig. 1. Basal cell tumour, solid (dog).

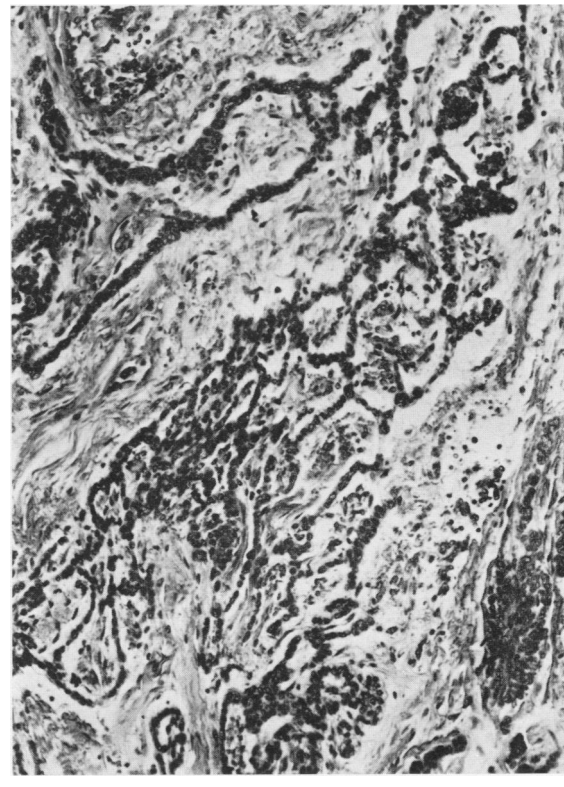

Fig. 2. Basal cell tumour, garland pattern (dog).

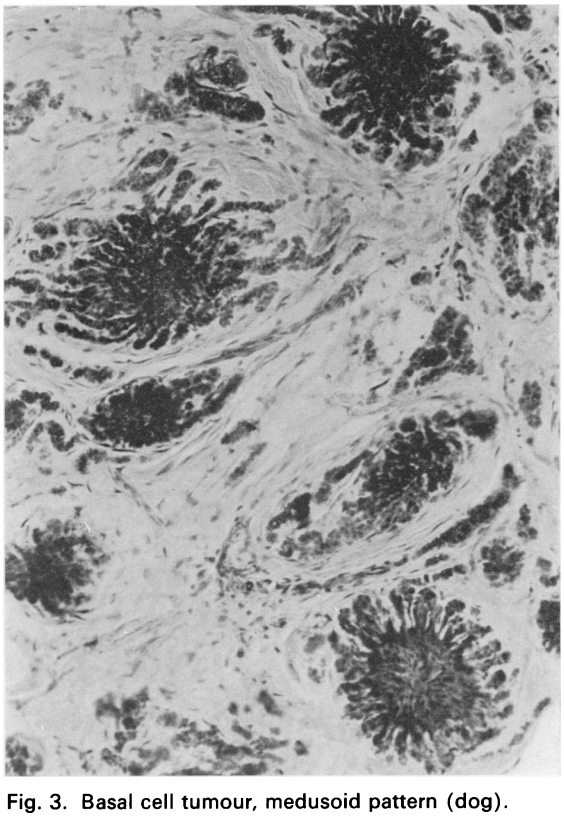

Fig. 3. Basal cell tumour, medusoid pattern (dog).

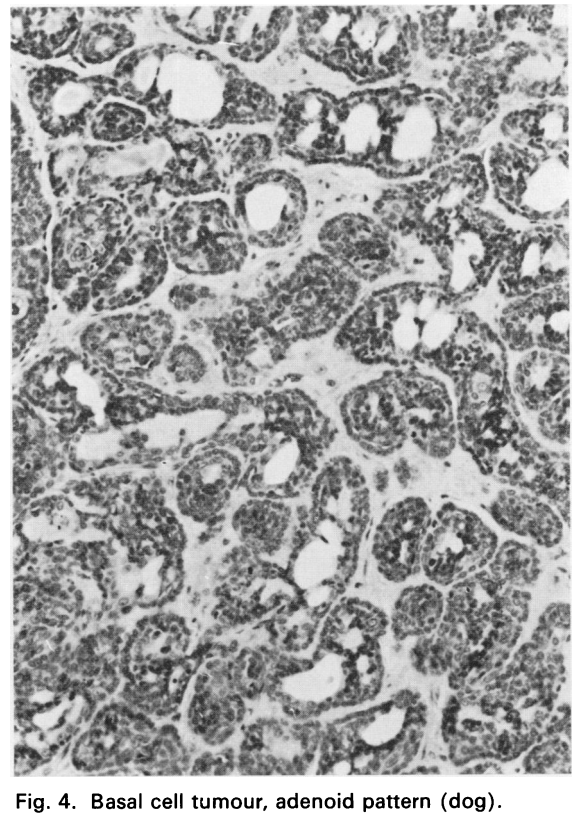

Fig. 4. Basal cell tumour, adenoid pattern (dog).

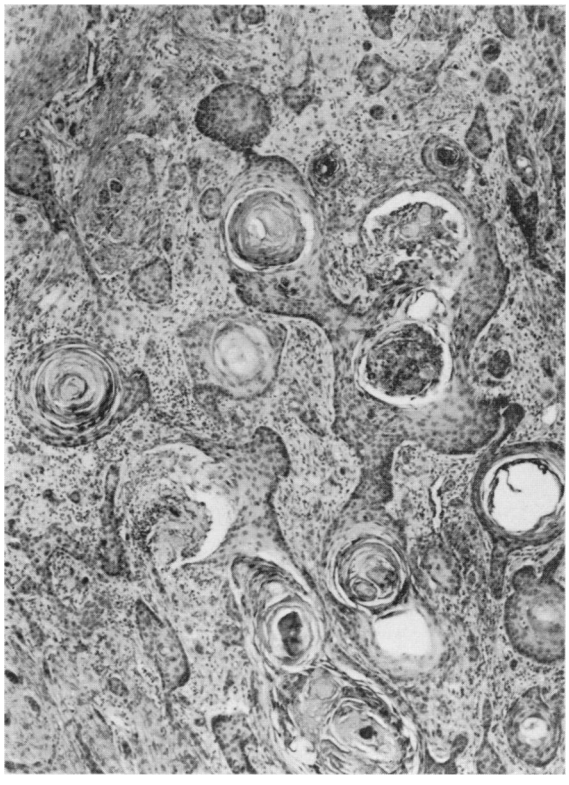

Fig. 5. Squamous cell carcinoma, well differentiated (dog).

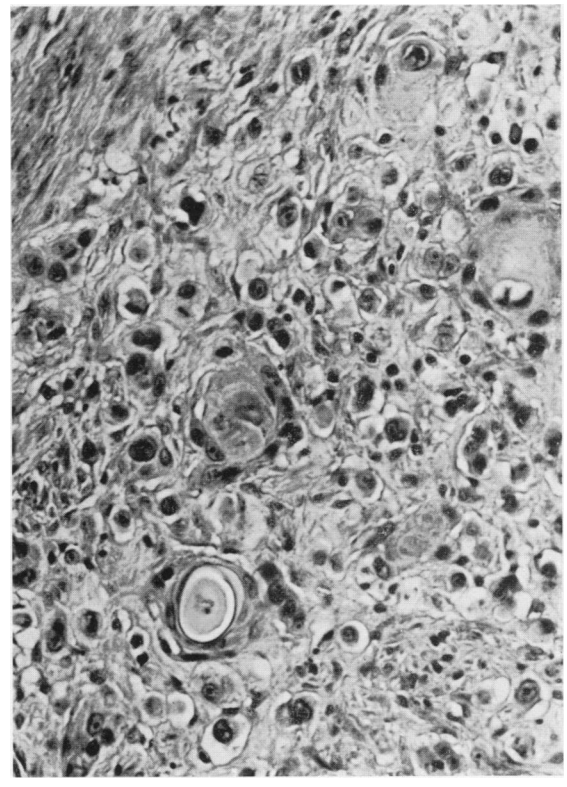

Fig. 6. Squamous cell carcinoma, poorly differentiated (dog).

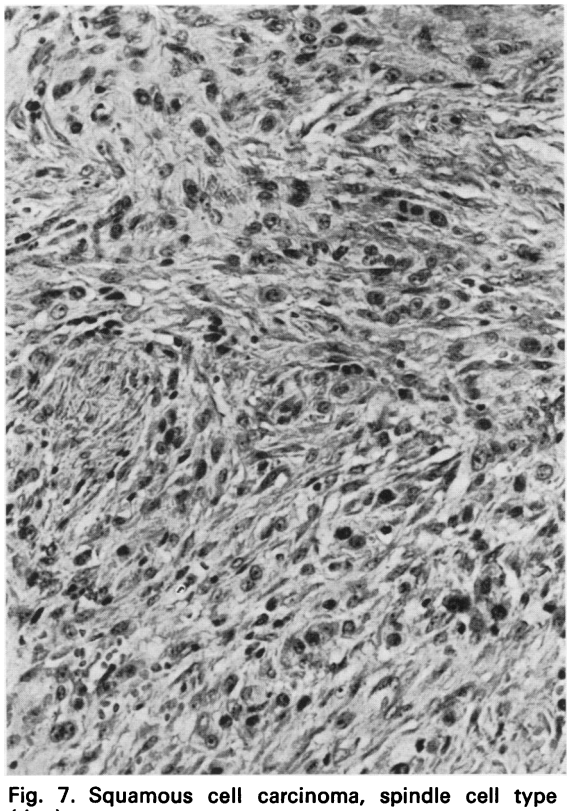

Fig. 7. Squamous cell carcinoma, spindle cell type (dog).

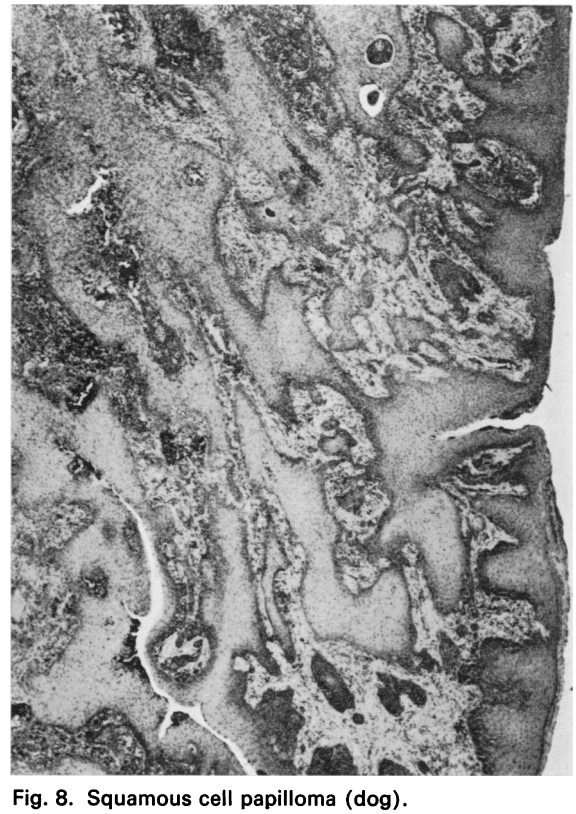

Fig. 8. Squamous cell papilloma (dog).

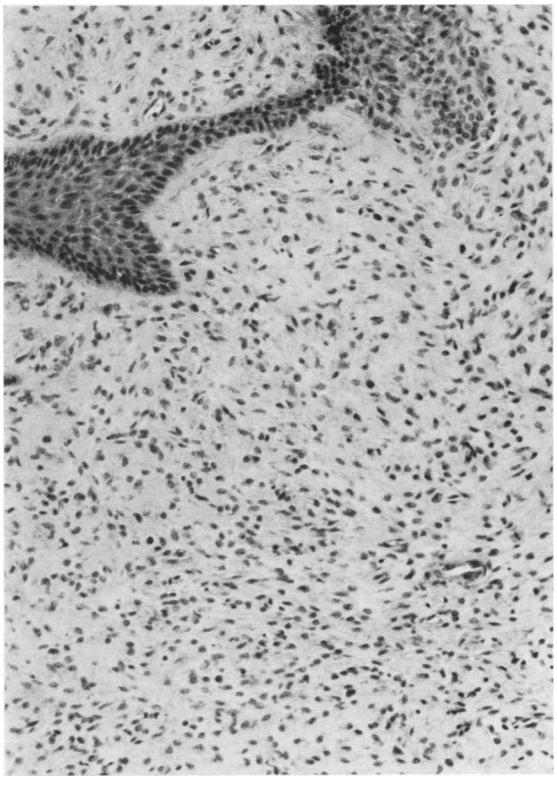

Fig. 9. Fibropapilloma (ox).

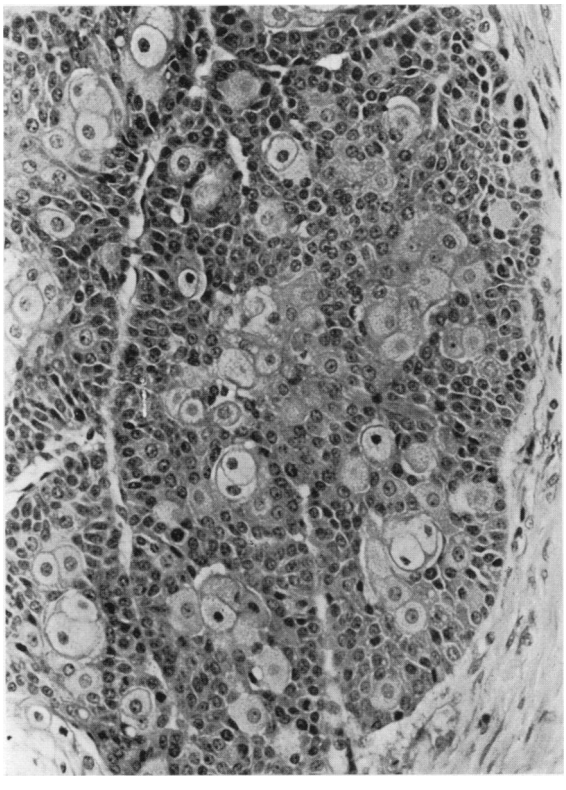

Fig. 10. Sebaceous adenoma, generative cells and cells with lipid vacuoles (dog).

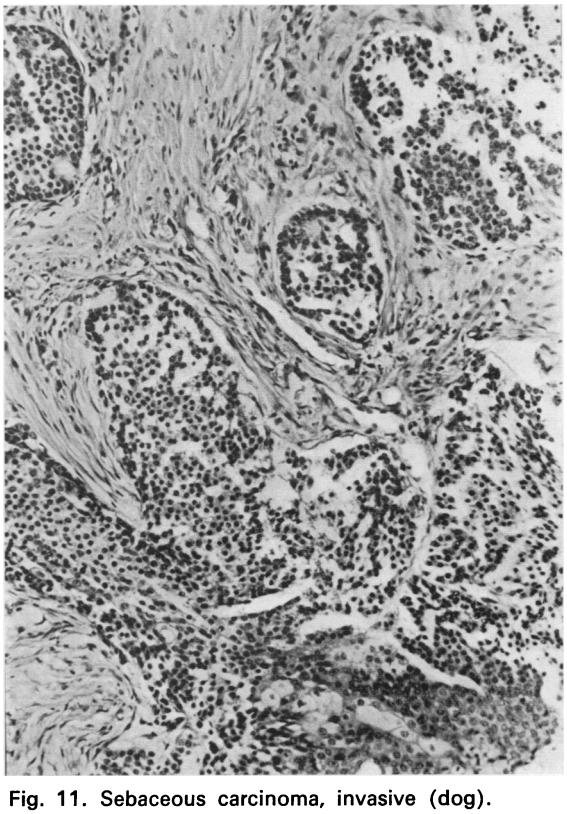

Fig. 11. Sebaceous carcinoma, invasive (dog).

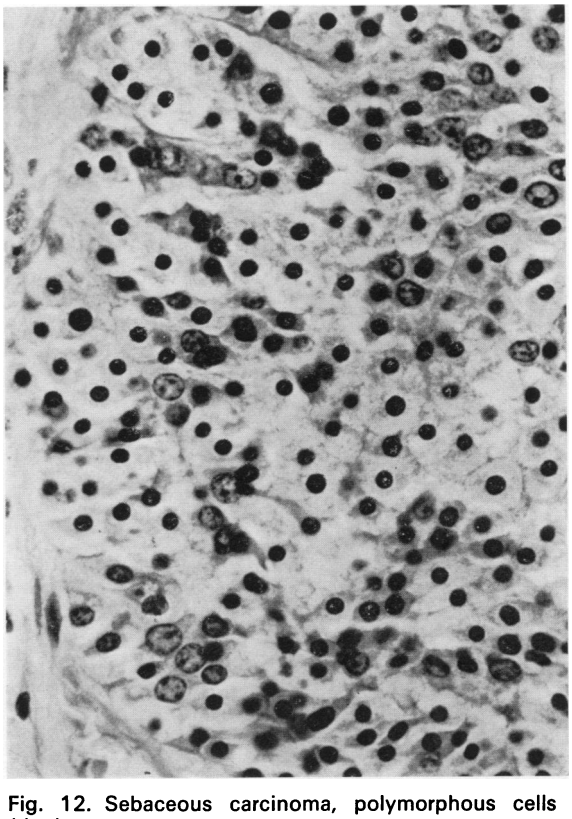

Fig. 12. Sebaceous carcinoma, polymorphous cells (dog).

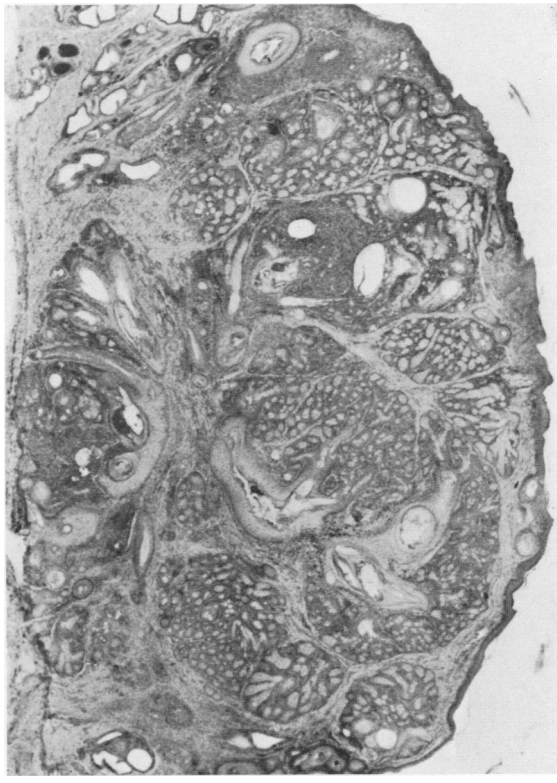

Fig. 13. Tumour-like hyperplasia of sebaceous gland (dog).

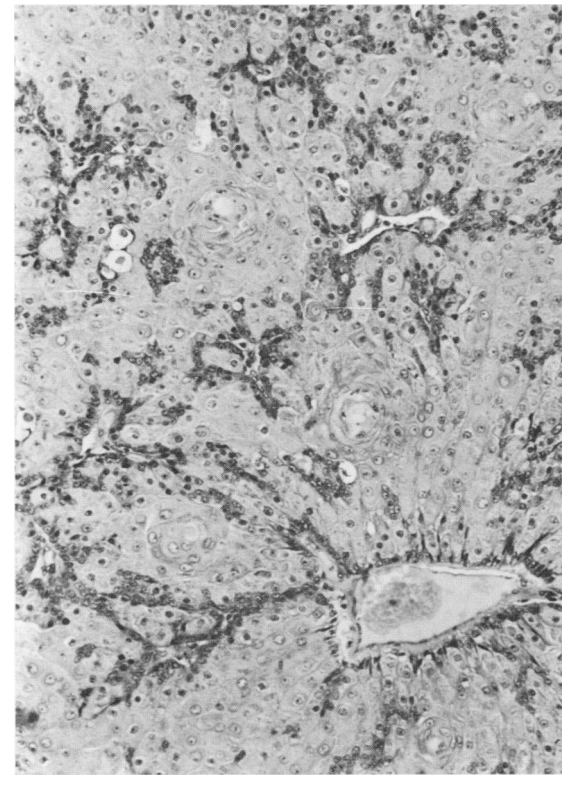

Fig. 14. Adenoma of hepatoid gland with secondary vascularization; reserve cells around vessels (dog).

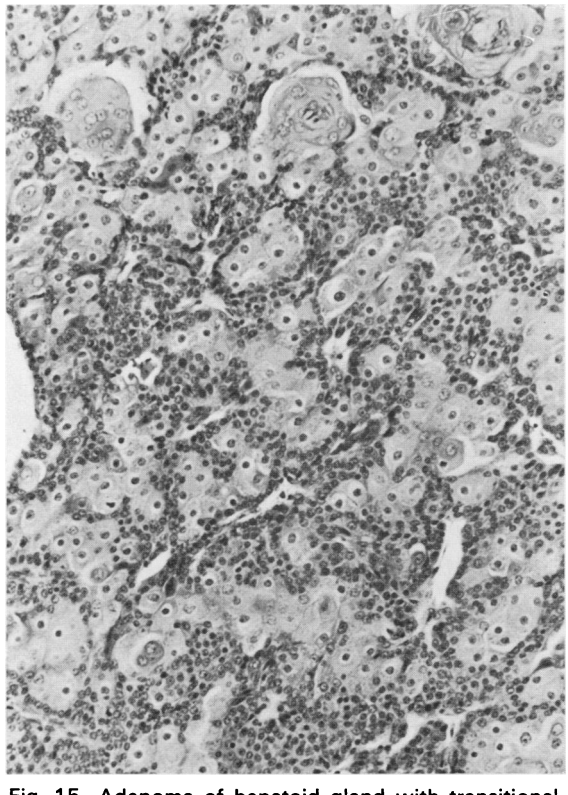

Fig. 15. Adenoma of hepatoid gland with transitional cells (dog).

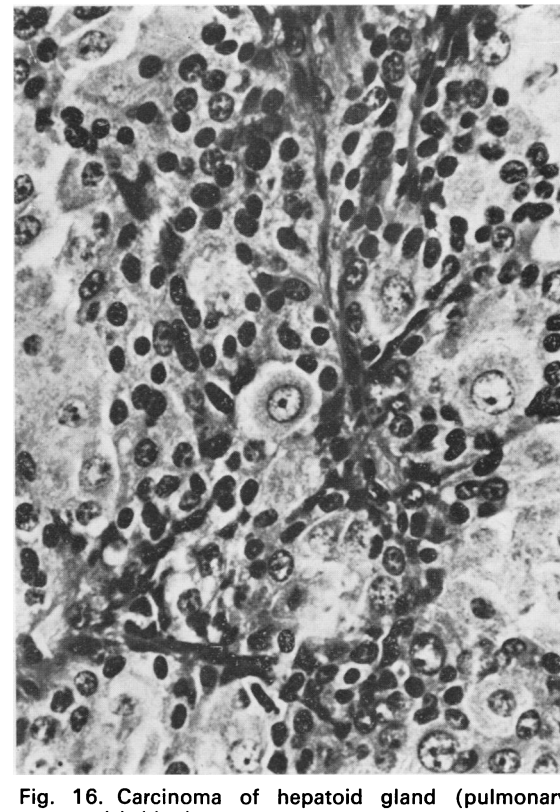

Fig. 16. Carcinoma of hepatoid gland (pulmonary metastasis) (dog).

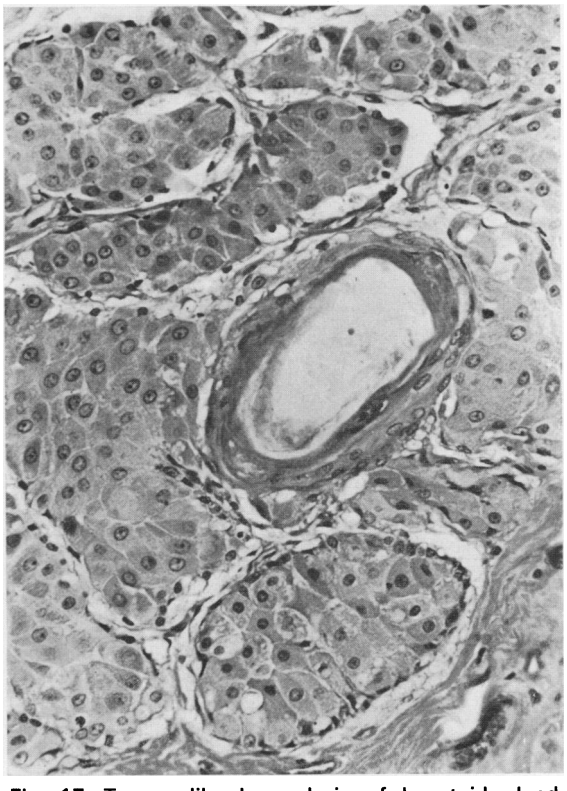

Fig. 17. Tumour-like hyperplasia of hepatoid gland (dog).

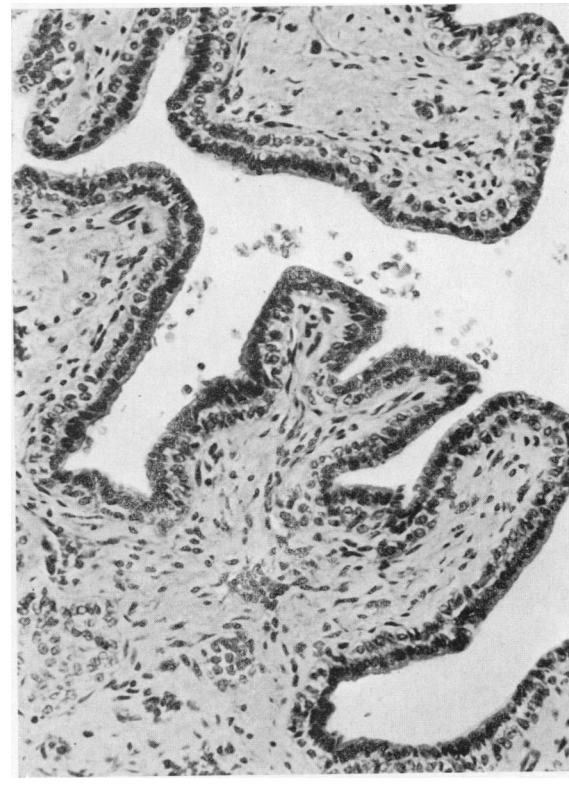

Fig. 18. Papillary syringadenoma (dog).

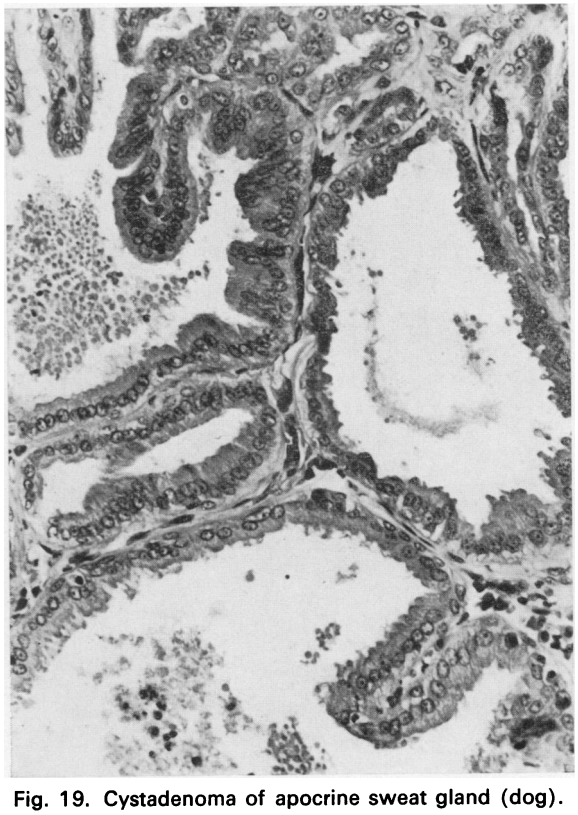

Fig. 19. Cystadenoma of apocrine sweat gland (dog).

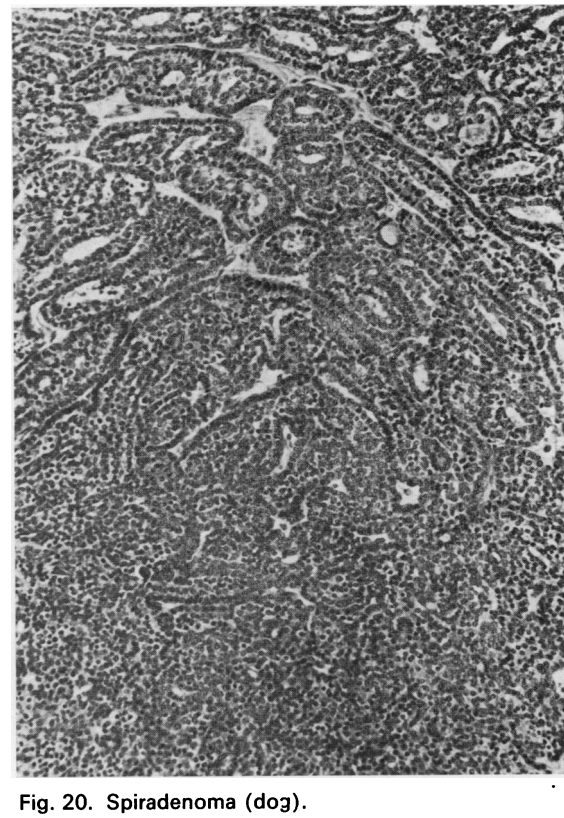

Fig. 20. Spiradenoma (dog).

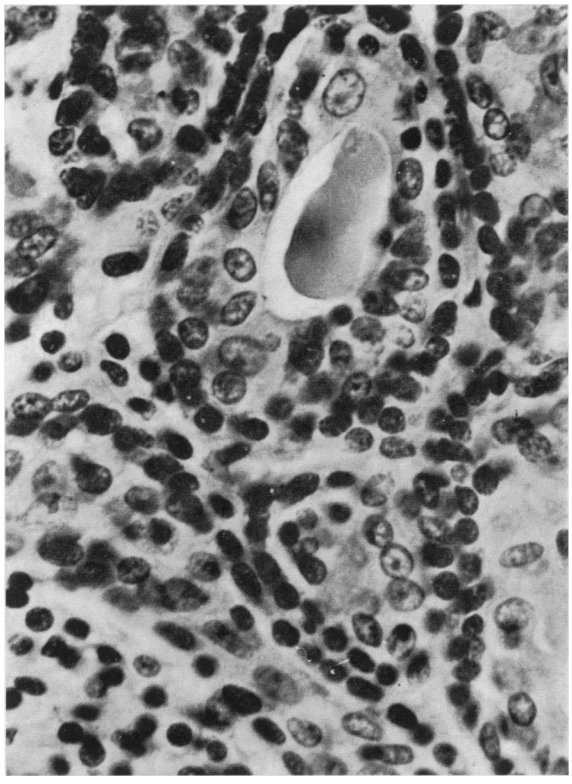

Fig. 21. Spiradenoma (dog).

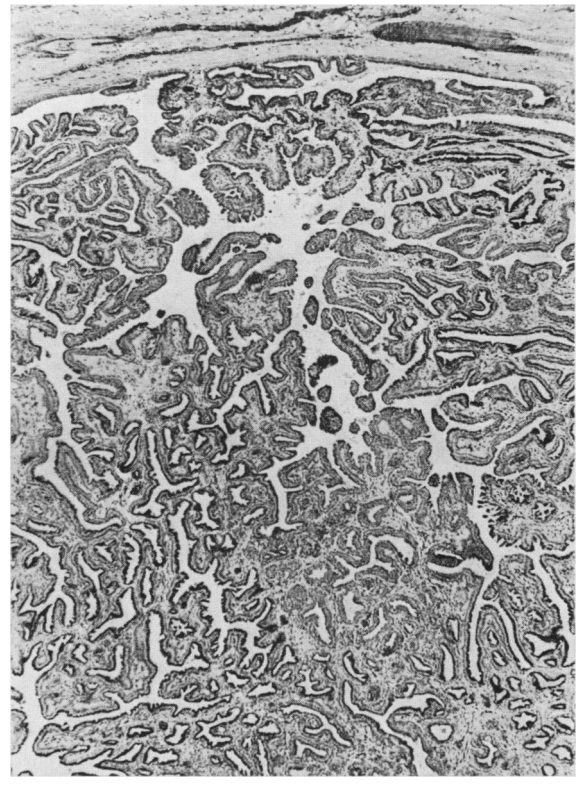

Fig. 22. Papillary carcinoma of apocrine sweat gland (dog).

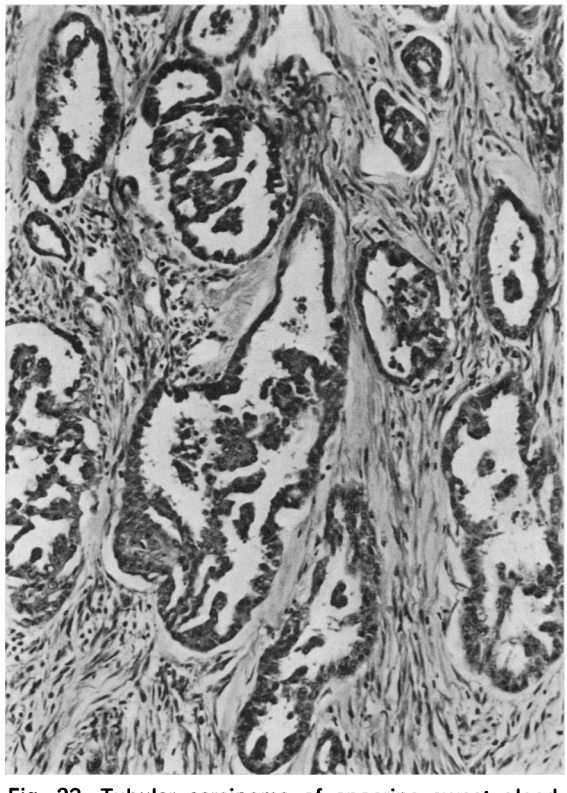

Fig. 23. Tubular carcinoma of apocrine sweat gland (dog).

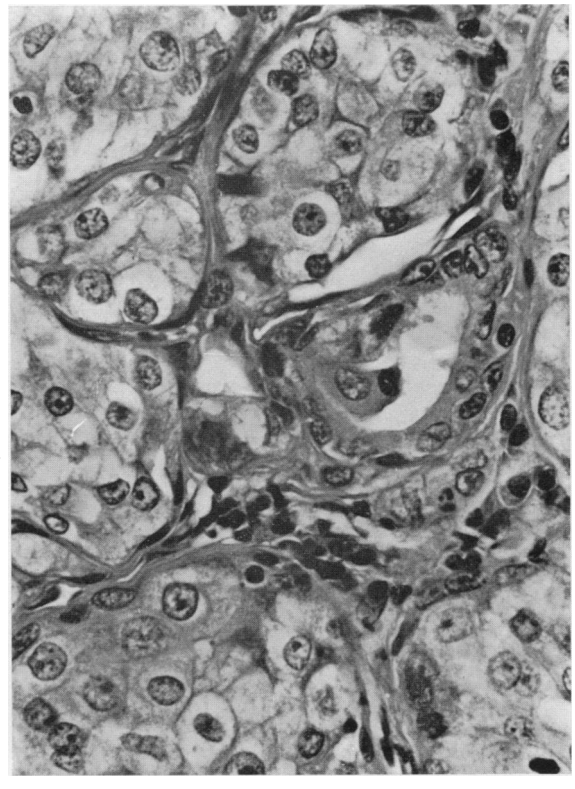

Fig. 24. Solid carcinoma of apocrine sweat gland (dog).

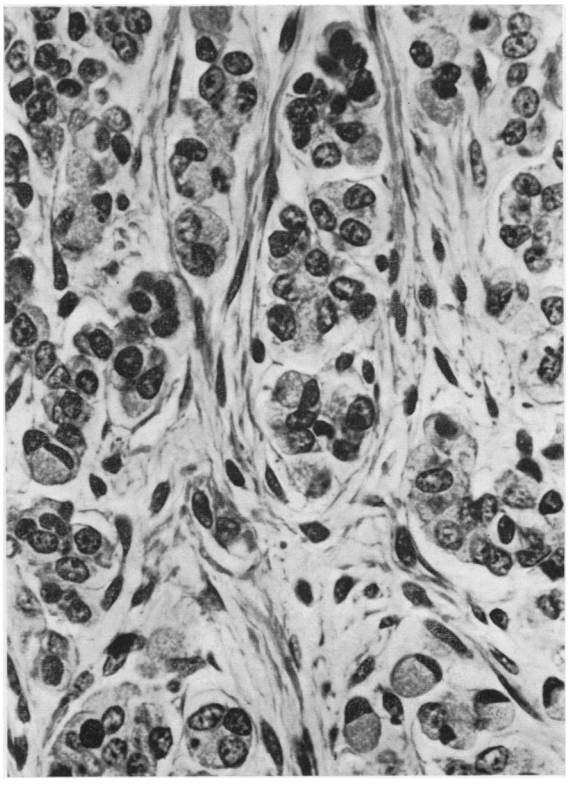

Fig. 25. Signet-ring-cell carcinoma of apocrine sweat gland (dog).

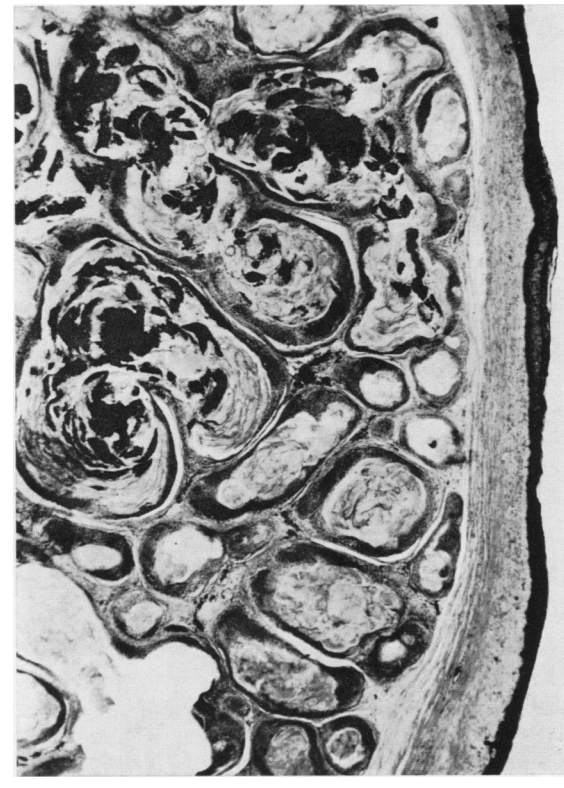

Fig. 26. Trichoepithelioma (dog).

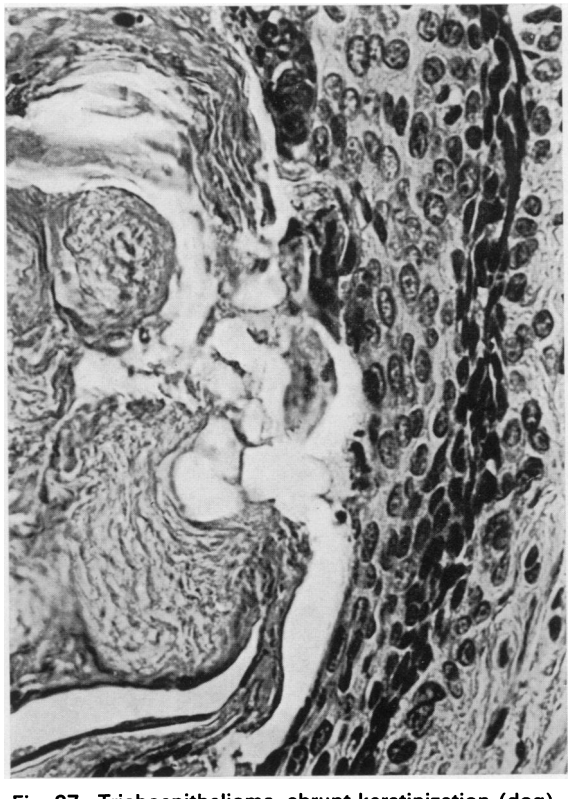

Fig. 27. Trichoepithelioma, abrupt keratinization (dog).

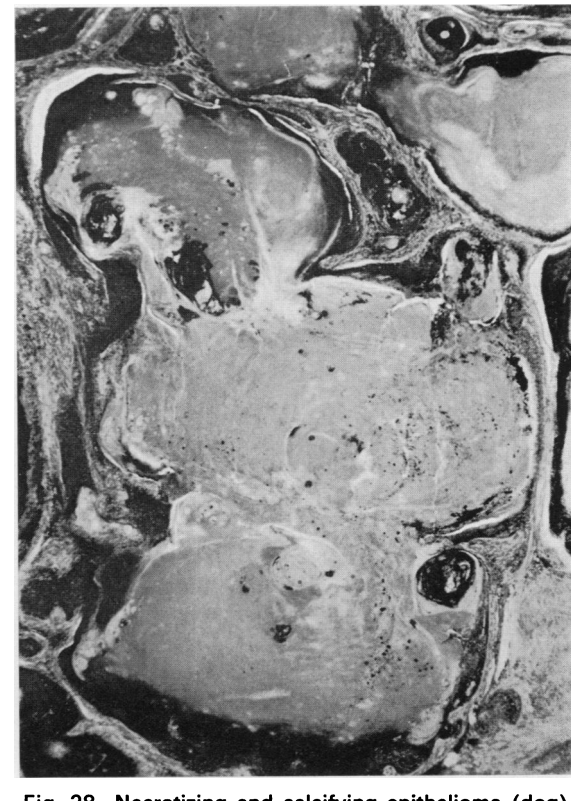

Fig. 28. Necrotizing and calcifying epithelioma (dog).

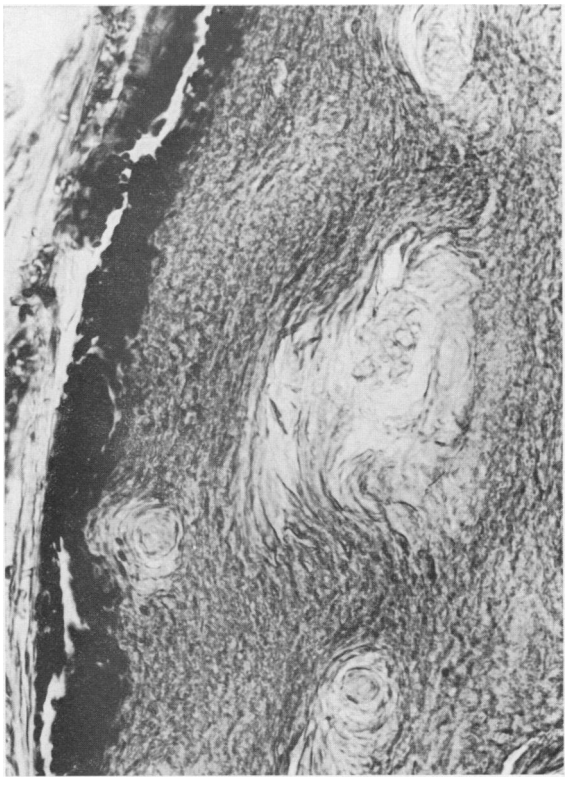

Fig. 29. Necrotizing and calcifying epithelioma, basophilic and " ghost " cells (dog).

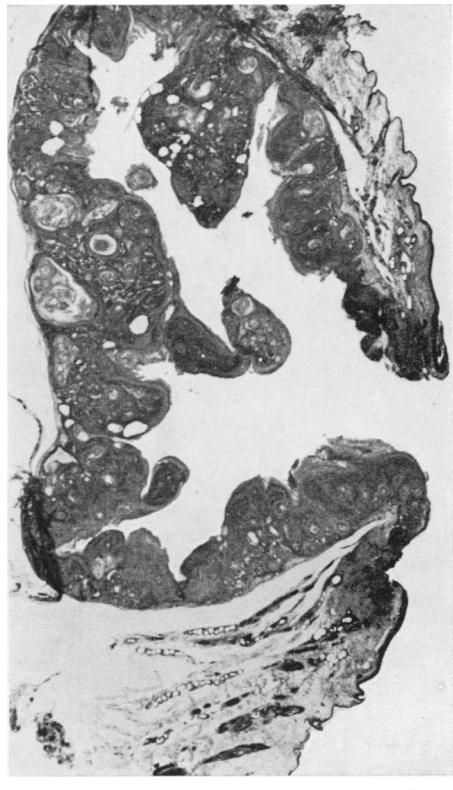

Fig. 30. Intracutaneous cornifying epithelioma (dog).

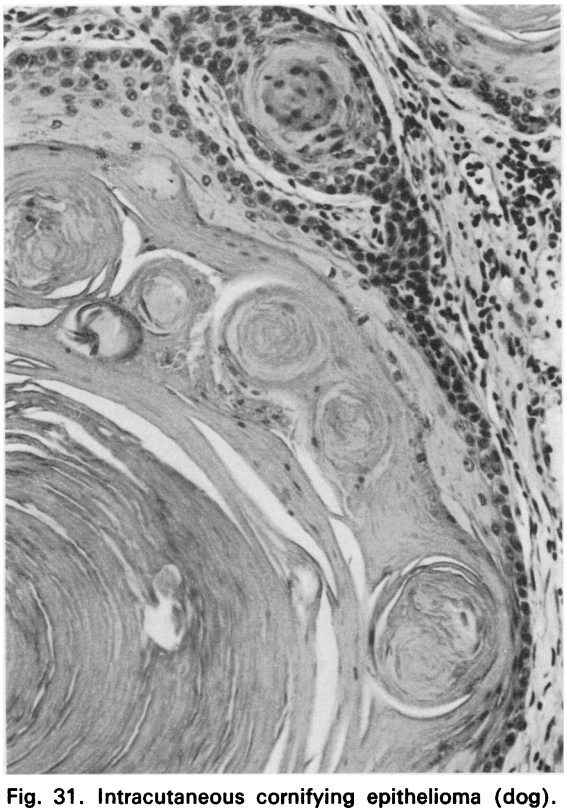

Fig. 31. Intracutaneous cornifying epithelioma (dog).

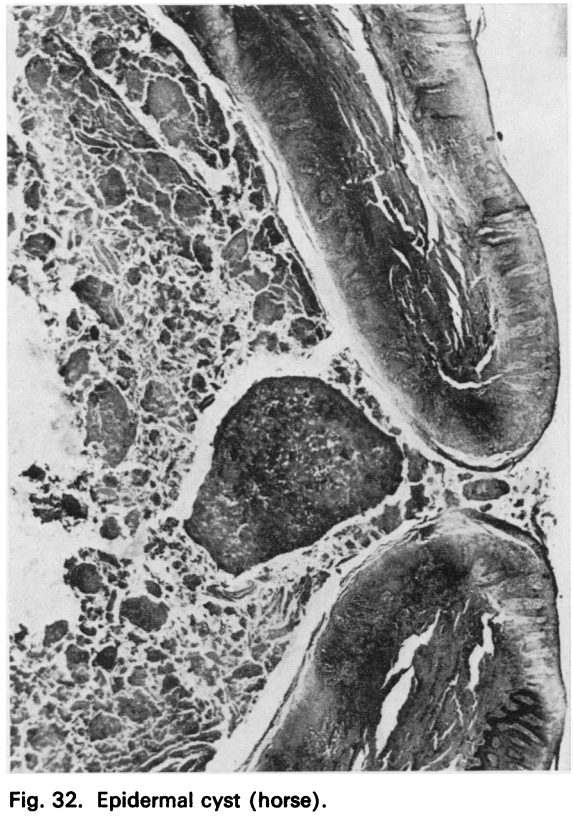

Fig. 32. Epidermal cyst (horse).

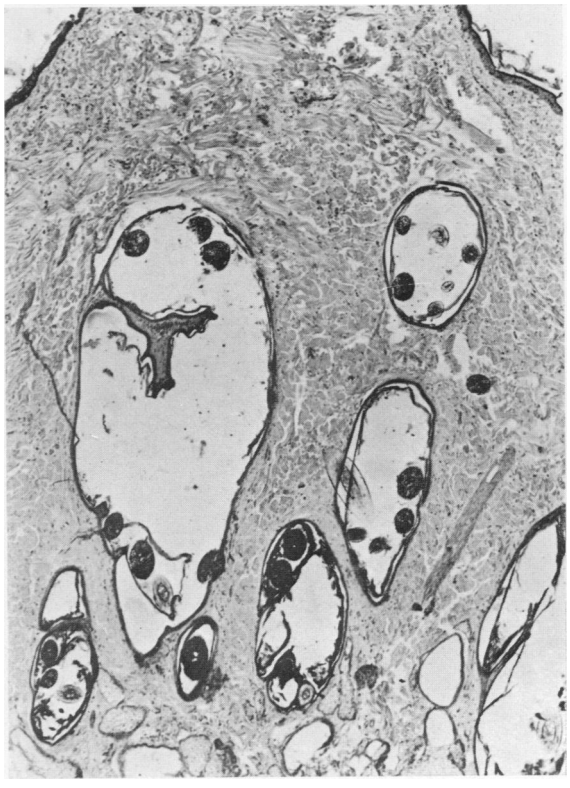

Fig. 33. Follicular cyst (dog).

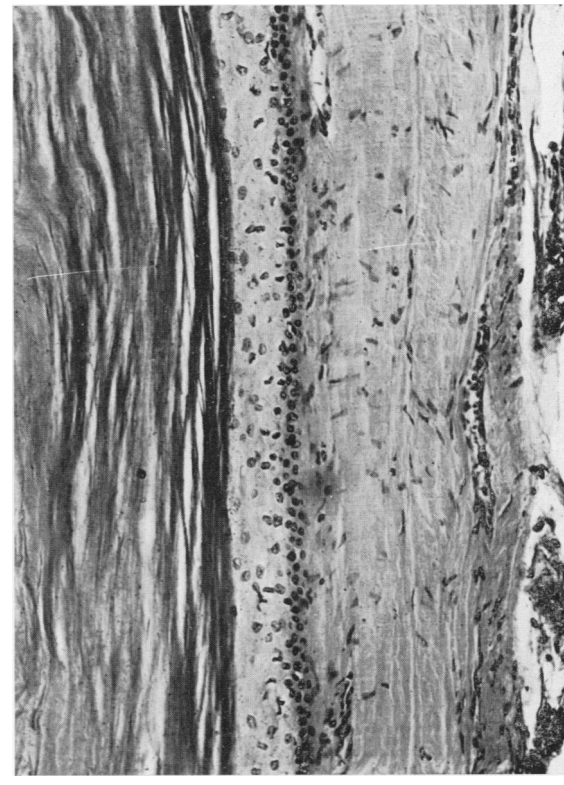

Fig. 34. Follicular cyst, close view of the wall (dog).

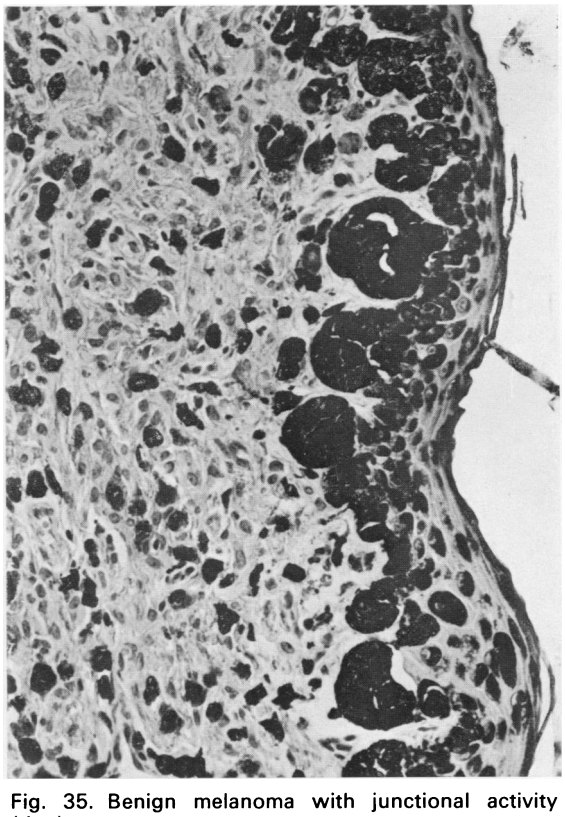

Fig. 35. Benign melanoma with junctional activity (dog).

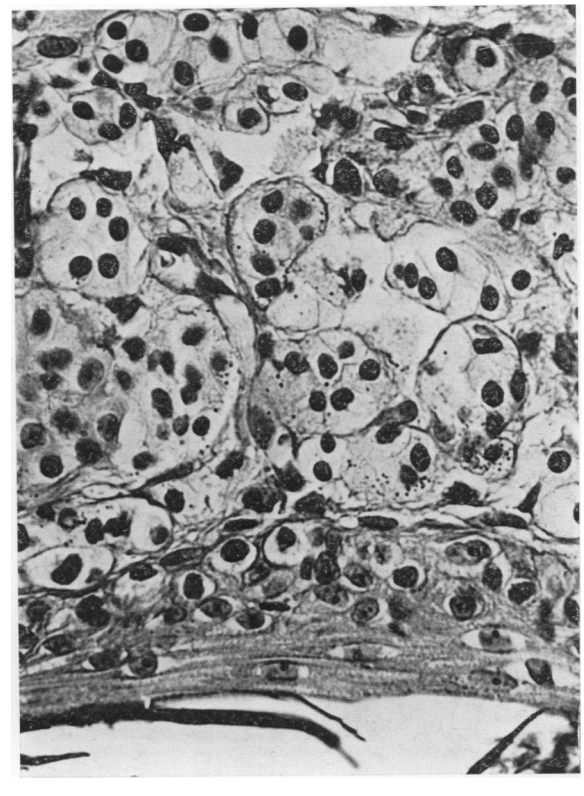

Fig. 36. Benign melanoma with junctional activity, bleached (dog).

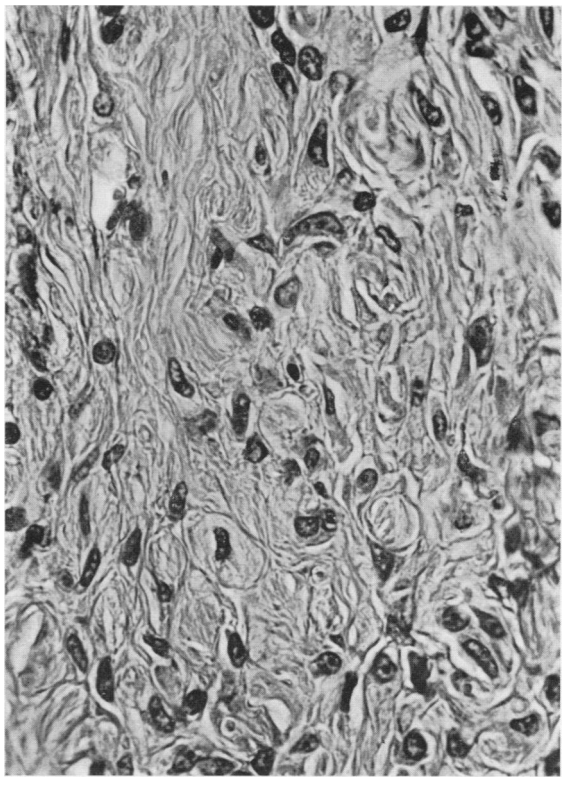

Fig. 37. Benign melanoma with junctional activity, deep fusiform cells, bleached (dog).

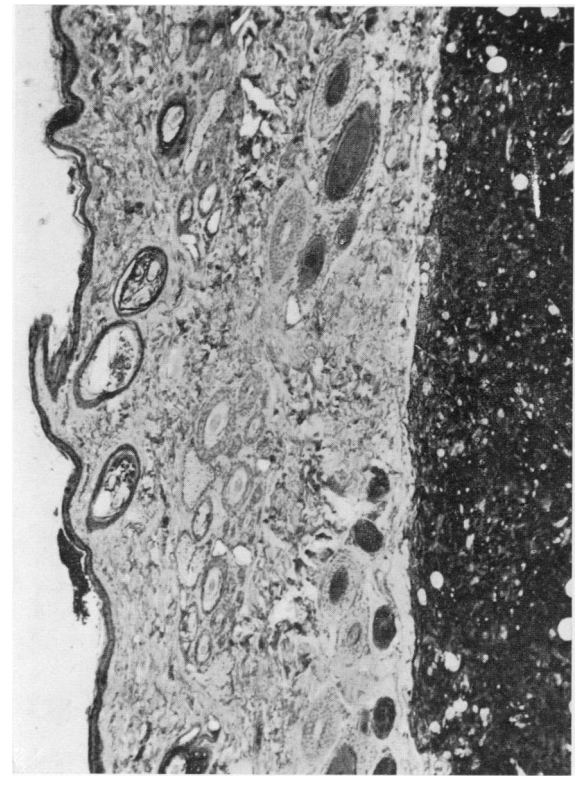

Fig. 38. Benign dermal melanoma, cellular type (dog).

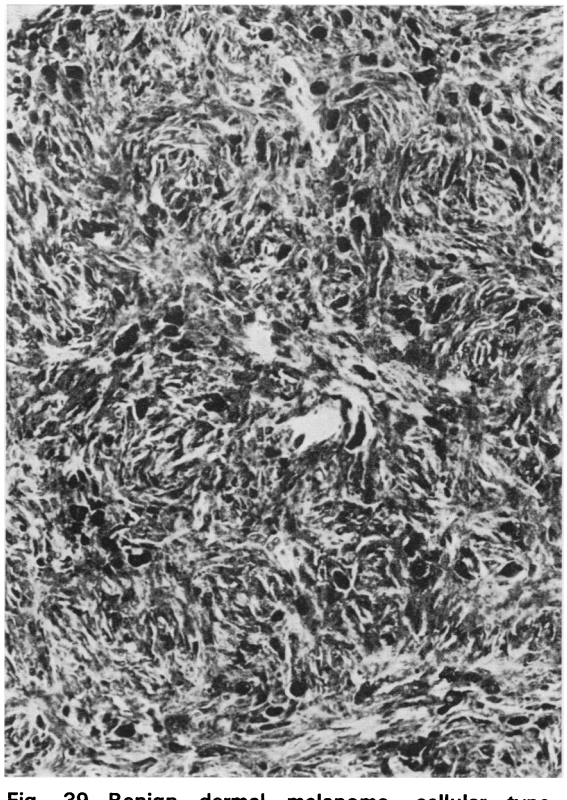

Fig. 39. Benign dermal melanoma, cellular type, whorled fusiform cells and melanophages (dog).

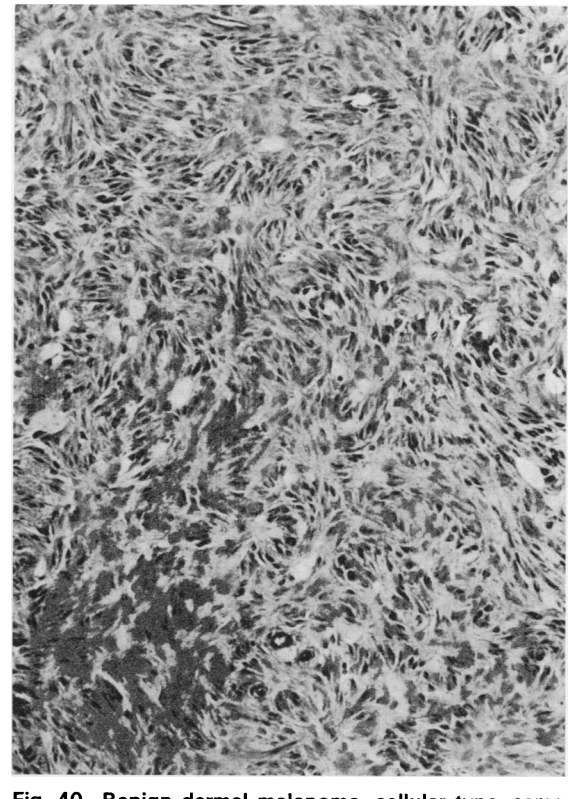

Fig. 40. Benign dermal melanoma, cellular type, same section as Fig. 39, bleached (dog).

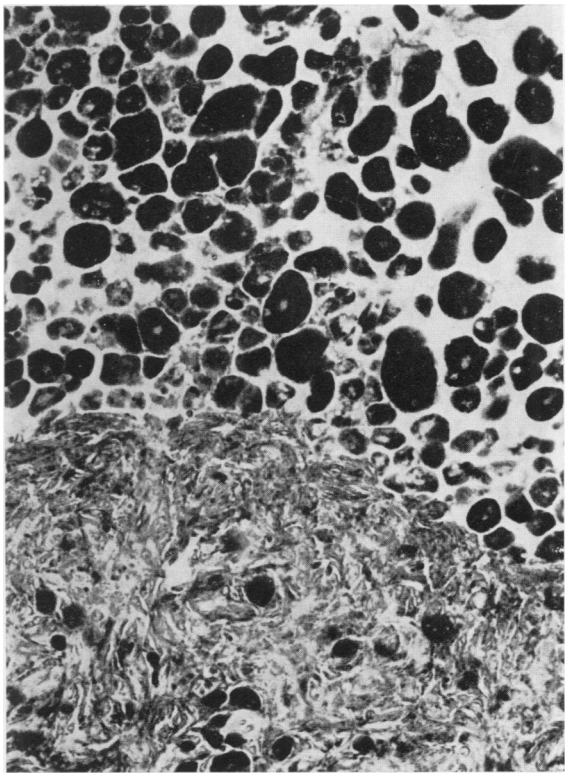

Fig. 41. Benign dermal melanoma, cellular type, whorled tumour cells and melanophages (dog).

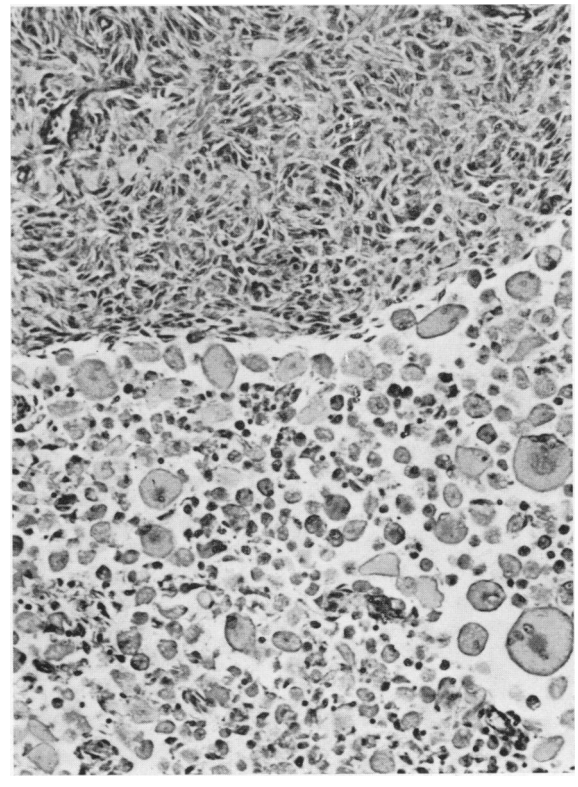

Fig. 42. Benign dermal melanoma, cellular type, same section as Fig. 41, bleached (dog).

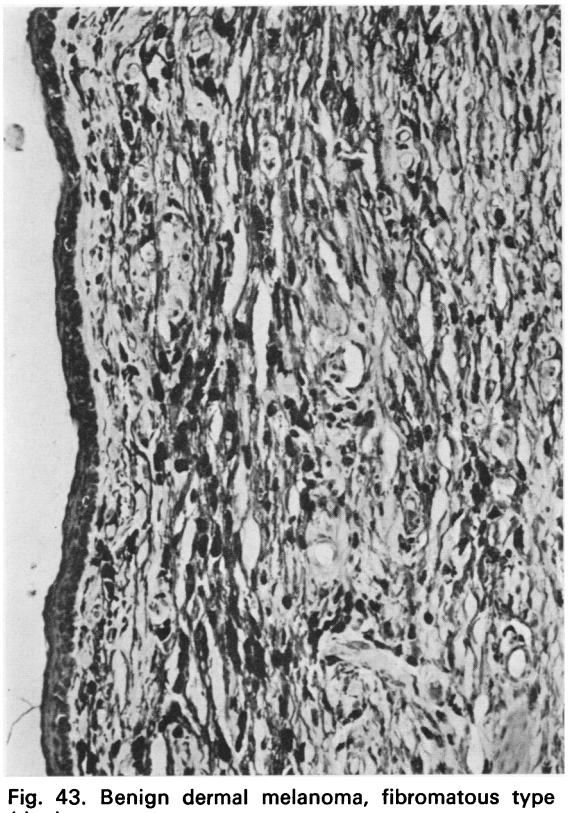

Fig. 43. Benign dermal melanoma, fibromatous type (dog).

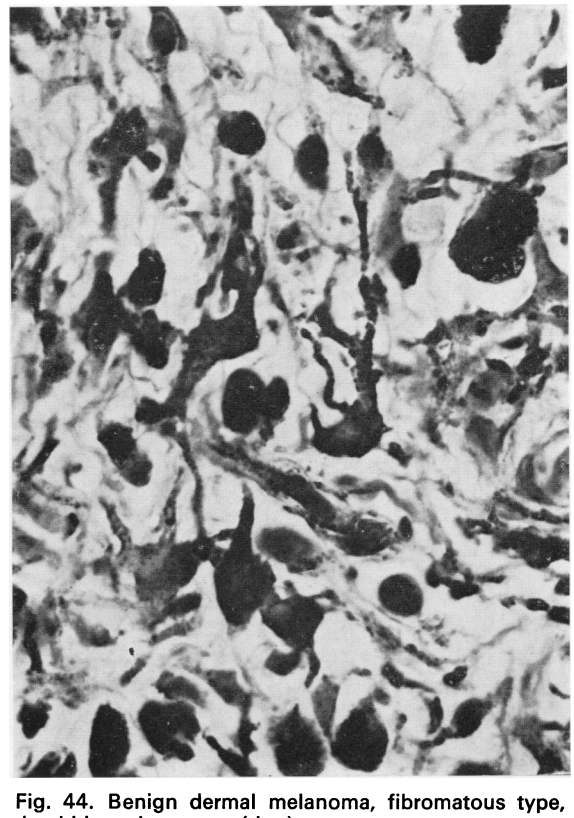

Fig. 44. Benign dermal melanoma, fibromatous type, dendritic melanocytes (dog).

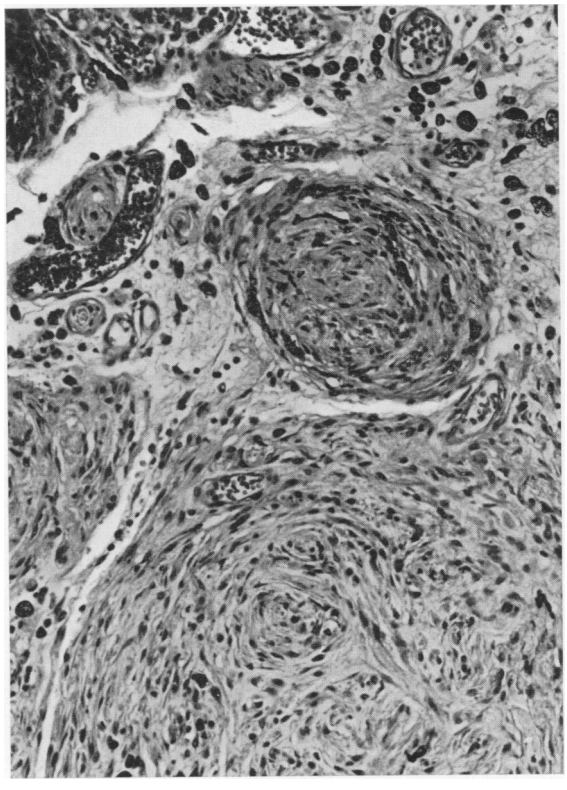

Fig. 45. Benign dermal melanoma, fibromatous type, fibroma-like pattern (dog).

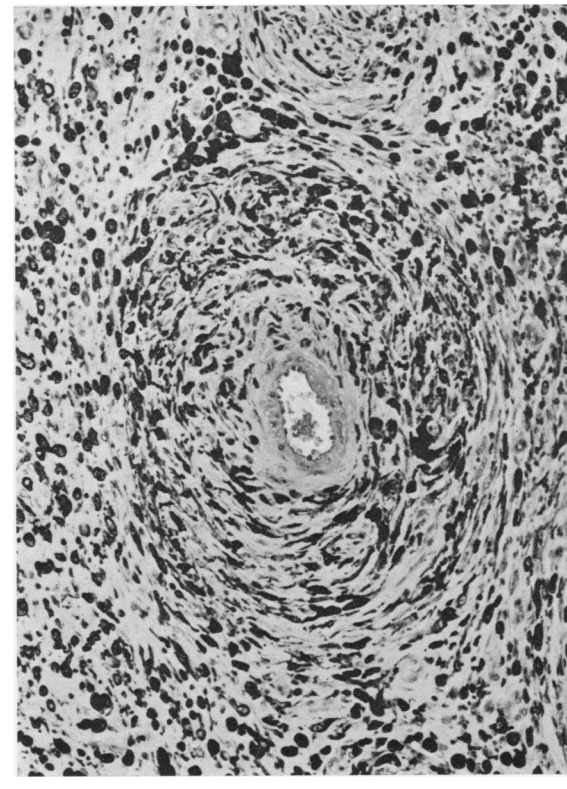

Fig. 46. Benign dermal melanoma, fibromatous type, tumour cells around artery (dog).

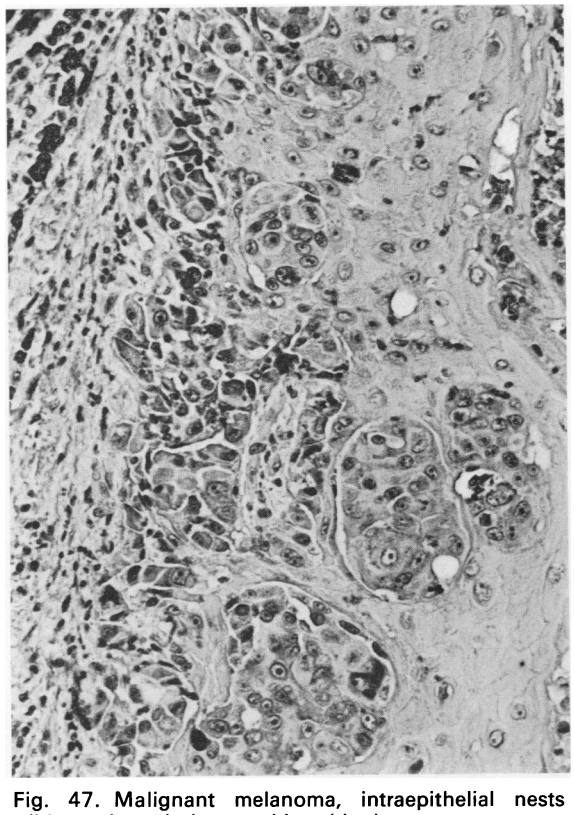

Fig. 47. Malignant melanoma, intraepithelial nests wiith atypia and pleomorphism (dog).

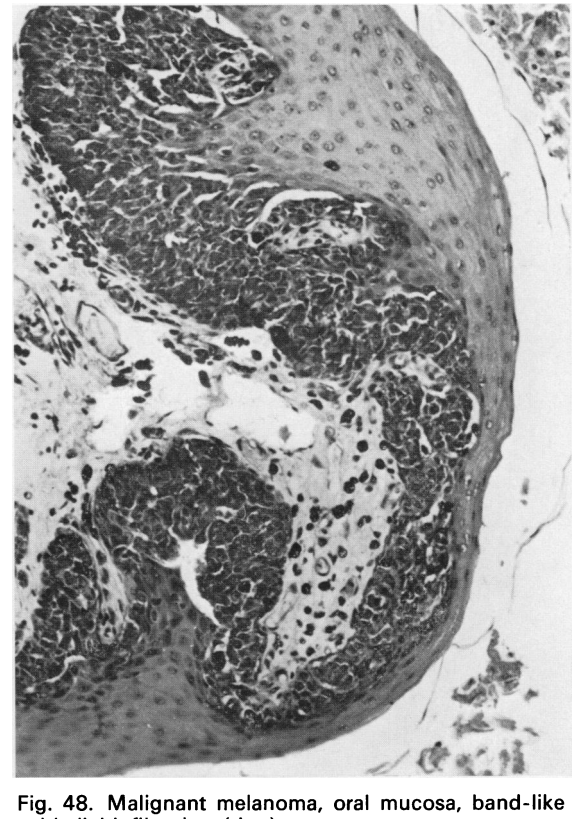

Fig. 48. Malignant melanoma, oral mucosa, band-like epithelial infiltration (dog).

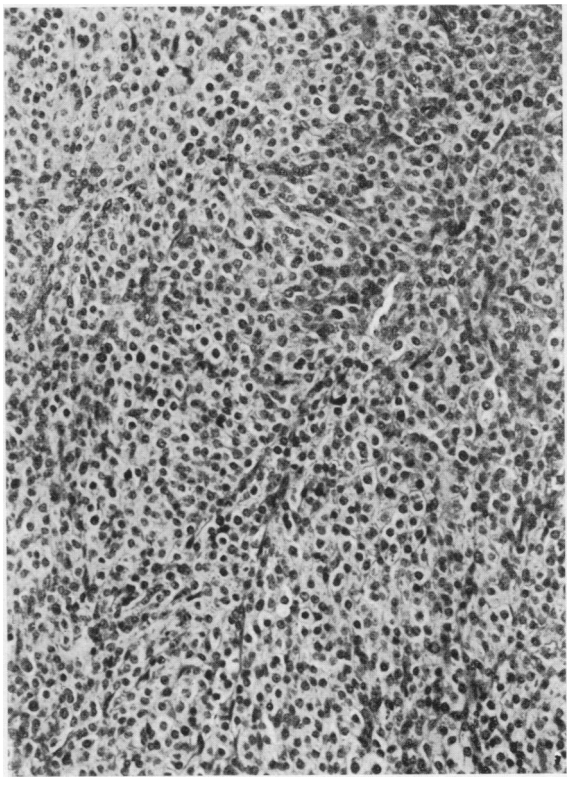

Fig. 49. Malignant melanoma, epithelioid type, amelanotic (dog).

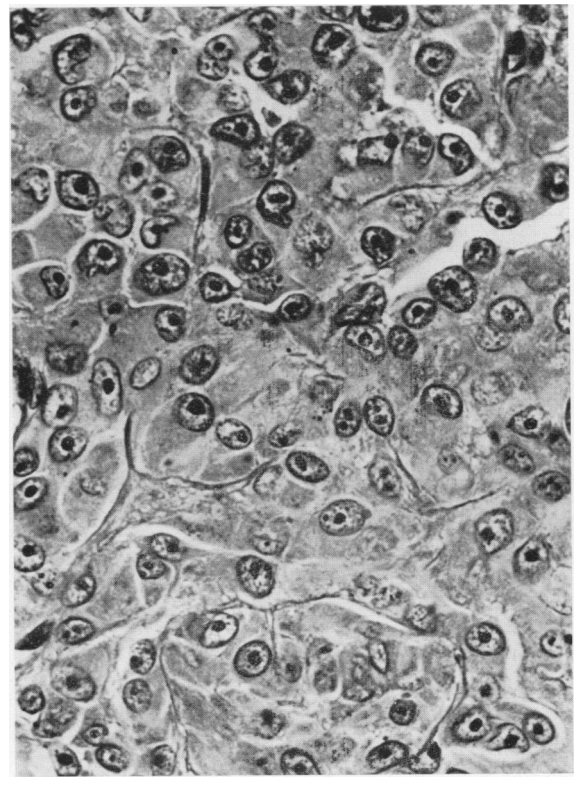

Fig. 50. Malignant melanoma, epithelioid type, amelanotic, prominent nucleoli (dog).

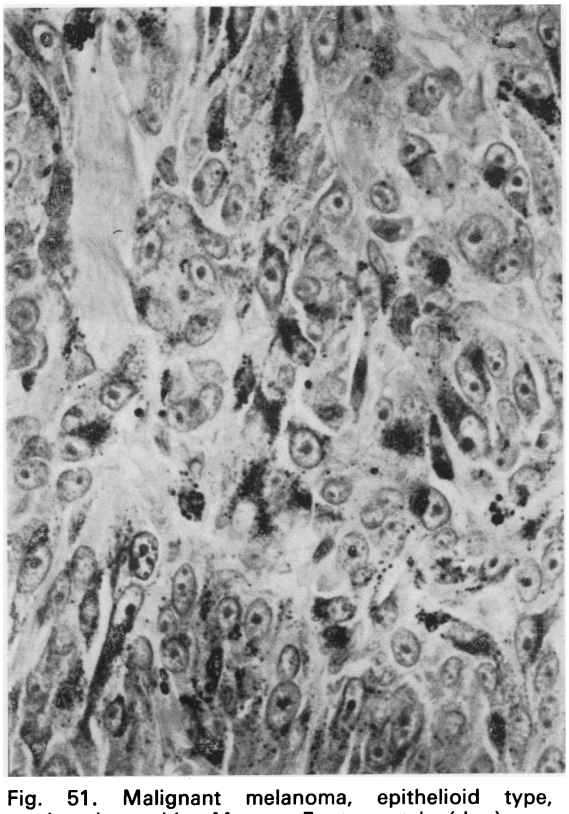

Fig. 51. Malignant melanoma, epithelioid type, amelanotic, positive Masson–Fontana stain (dog).

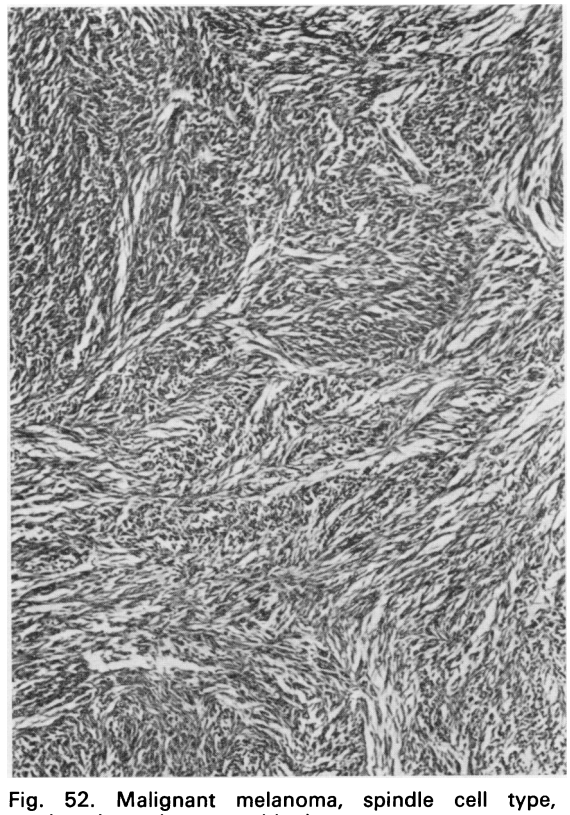

Fig. 52. Malignant melanoma, spindle cell type, amelanotic, oral mucosa (dog).

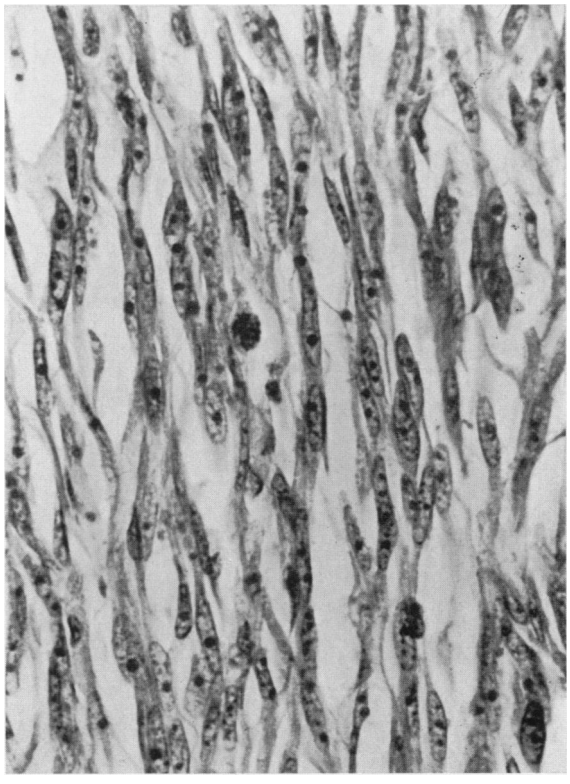

Fig. 53. Malignant melanoma, spindle cell type, amelanotic, oral mucosa (dog).

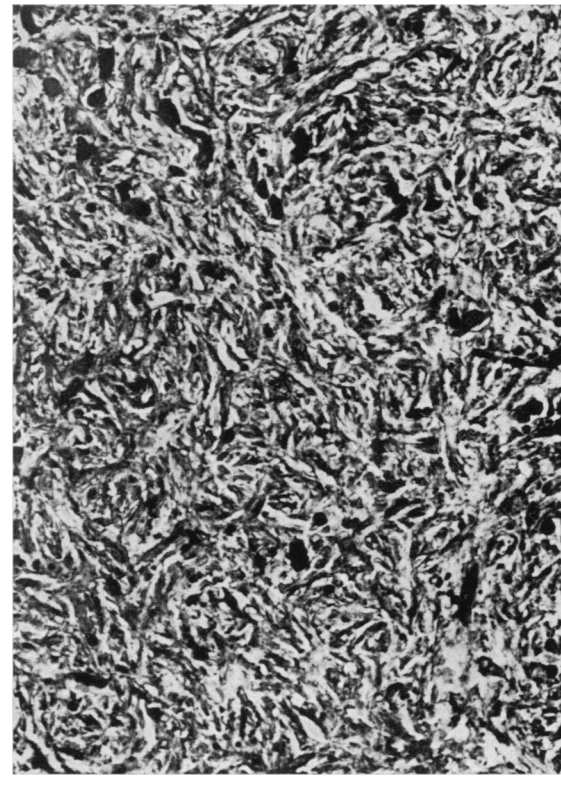

Fig. 54. Malignant melanoma, dendritic and whorled type (dog).

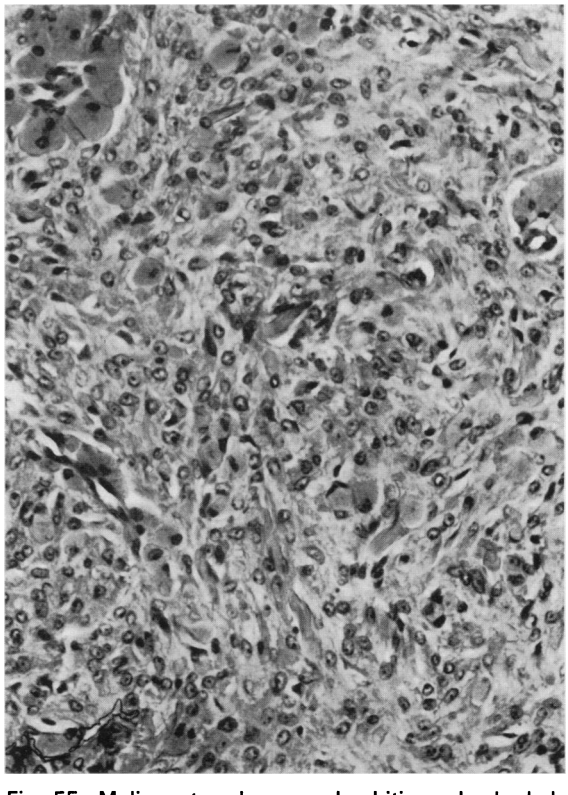

Fig. 55. Malignant melanoma, dendritic and whorled type, same section as Fig. 54, bleached (dog).

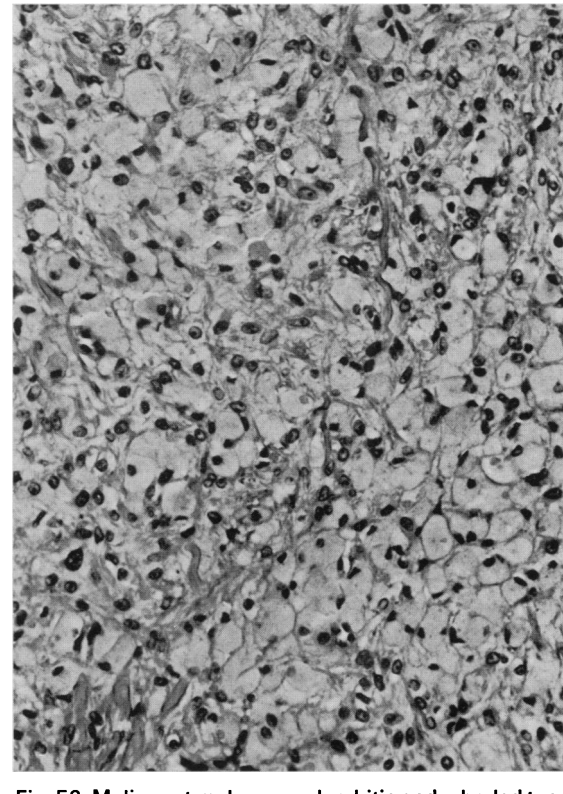

Fig. 56. Malignant melanoma, dendritic and whorled type, large cells, probably melanophages, bleached (dog).

4. *Mixed tumour of apocrine sweat glands.* These rare tumours can be benign or malignant. Glandular epithelium, myoepithelial elements, and chondroid and osteoid tissues may be present.

5. *Carcinoma of apocrine sweat glands* (Fig. 22–25). These malignant tumours are less common than the benign tumours. They can be regarded as malignant counterparts of the benign variants (F1–4) described above only if they can be recognized as being derived from one of these types. Often that is not possible and they are then subdivided into (*a*) *papillary carcinoma*, (*b*) *tubular carcinoma*, (*c*) *solid carcinoma*, and (*d*) *signet-ring-cell carcinoma*. The most common type is (*c*), the others being encountered only rarely. Metastases are frequent.

G. *Tumour of hair follicle*

Trichofolliculoma, trichilemmoma, and inverted follicular keratosis, which occur in man, have not yet been described in animals.

1. *Trichoepithelioma* (Fig. 26, 27). This benign, well-demarcated subcutaneous tumour is composed of multiple horn cysts. Keratinization is abrupt, as in normal hair follicles. The surrounding stromal tissue simulates the " glassy skin " and connective tissue membrane of normal hair follicles. Melanin pigmentation and foreign body reaction with macrophages and giant cells, calcification, and purulent inflammation due to secondary bacterial infection are frequent. The tumour is common in dogs but not in other species, and is mainly localized on the back, not on the head or lower extremities.

2. *Necrotizing and calcifying epithelioma (Malherbe)* (Fig. 28, 29). This benign tumour, also known as " pilomatrixoma ", is localized in the lower corium and subcutis and is composed of two types of cell. In the periphery of the epithelial masses are the basophilic cells, resembling those of basal cell tumours. In the more central areas are the so-called " ghost cells ", pinkish with haematoxylin and eosin stain, with distinct cell borders and only shadows of the nuclei. They are derived from the basophilic cells, which are common in young tumours and less common or nearly absent in older ones. Areas of keratinization are regularly to be found within the basophilic layer and among the " ghost cells ". Calcification, as large deposits or dusty granules in the ghost cells, is a frequent but not constant feature. Osseous metaplasia also can occur. Foreign body reactions, as in trichoepithelioma, are common. The tumour is frequent in dogs but not in other species. The main localization is the trunk.

H. *Intracutaneous cornifying epithelioma (" keratoacanthoma ")* (Fig. 30, 31)

This benign, well-encapsulated cutaneous tumour is composed of single or multiple cavities lined by stratified cornifying squamous cell epithelium with the stratum granulosum often lacking. Frequently there are papillary projections into the lumen. The cavities are mostly filled with lamellated, concentrically arranged or homogeneous horny material, frequently mixed with cholesterol crystals. Often an epithelial pore furnishing a direct connexion between cavity and epidermal surface is present. Melanin pigmentation and calcification are scanty. Foreign body and other inflammatory reactions as in trichoepithelioma and epithelioma of Malherbe can be encountered in more than 90% of the tumours, especially in ruptured ones. The tumour, which is more rare than trichoepithelioma, has been described only in dogs. The neck and trunk are the main localizations.

This tumour of dogs is designated as keratoacanthoma in the USA, as it is considered to be the counterpart of the lesion of that name in man. But, according to the WHO histological typing of skin tumours, keratoacanthoma in man is a rapidly developing elevated lesion composed of squamous epithelium with excessive keratin formation filling a central crater; from the elevated area strands of epidermal cells, often intercommunicating, infiltrate the dermis, commonly reaching close to the subcutaneous tissue; the borders of the crater show lipping towards the centre and the surrounding epidermis shows acanthosis over a short distance. The main reasons for not regarding intracutaneous and cornifying epithelioma in dogs as the counterpart of keratoacanthoma in man are their lack of elevation in the early stages, their origin in deeper areas of the skin, and their multiplicity. Histogenetically, it is thought—but not proved—that the tumour in dogs arises from epidermal or follicular cysts.

J. *Cysts*

1. *Epidermal cyst* (Fig. 32). The wall of the cyst corresponds to the normal epidermis, but it is often atrophic owing to the pressure of the keratinous material within the cyst. A pore may be seen. Foreign-body reaction with giant cells and macro-

phages occurs regularly after rupture of the cyst. Epidermal cysts are considered to arise from heterotopic epidermis and may be single or multiple. They are common on the head, neck, and sacral region.

2. *Dermoid cyst.* The wall of the cyst is composed of epidermis with rete pegs and adnexal elements, such as hair follicles and sebaceous glands. The cysts are filled with keratinous and sebaceous material, cholesterol crystals, and rolled-up hairs. Pore formation and foreign-body reaction correspond to these features in epidermal cysts. A curiosity is the dermoid cysts (dermoid sinuses) that occur commonly on the median line of the back of Rhodesian ridgeback dogs.

3. *Follicular cyst* (Fig. 33, 34). Follicular cysts, which are the most common cysts in animals, develop by retention of follicular or glandular products owing to congenital or acquired loss or obliteration of excretory ducts or follicular orifices. The walls of the cysts are composed of a basal layer of cylindric or cubic squamous cells, followed by various numbers of cell layers simulating stratum spinosum and a zone of abrupt keratinization. Rete pegs are not present, in contrast to dermoid cysts. The cysts are filled with horny cells or lamellae, hairs, and cholesterol crystals. Frequently sebaceous or apocrine sweat glands or atrophic hair follicles are seen running into the base of the cyst. Inflammatory reactions, especially those to foreign bodies, are common. Sebaceous cysts are very rare, whereas sweat gland cysts lined by a single, mostly cylindric, epithelium are common in old dogs.

4. *Cyst with epithelial proliferation.* Proliferation of squamous cell epithelium into the lumina of epidermal and follicular cysts can be found and is considered as an early stage of intracutaneous cornifying epithelioma.

II. TUMOURS OF MELANOGENIC SYSTEM

The tumours of the melanogenic system are poorly understood. There are large differences between species of domestic animal in the occurrence of pigmented neoplasms. These tumours are common in old grey horses and in dogs, uncommon in cattle and pigs, and rare in cats and sheep. They are not identical morphologically in different species and their histogenesis is almost entirely unknown. This applies especially to the problem of the naevus cell phenomenon, which plays a most important role in the discussion of human pigment cell neoplasms. Comparable conditions seem to exist only in dogs and pigs.

For these reasons it seems impossible at present to give a classification valid for all domestic animals. Therefore the following classification deals only with oral and skin melanomas in the dog, in which these lesions have been well studied. It is based on the authors' investigations of 700 canine oral and skin melanomas collected in the Departments of Pathology of the Universities at Giessen and Munich. Melanomas of the oral cavity are included because they are very similar to their malignant skin counterparts. The main difference between these tumours is that nearly all oral melanomas of the dog are malignant, whereas malignant skin melanomas are far less frequent than is commonly believed.

A. *Benign melanoma*

1. *Benign melanoma with junctional activity* (Fig. 35–37). The presence of junctional cell nests is characteristic. In most instances these tumours are heavily pigmented, thus obscuring structural details. The cell clusters may be distributed over the whole surface of the tumours but are more frequently localized. Similar nests can be found in the hair follicles. After bleaching, the junctional cell nests are seen to be composed of varying numbers (3–20) of rounded or polygonal cells with spherical or ovoid nuclei. Below the junctional nests trabecular structures, which are mostly well pigmented, are often found. Often pigment content decreases with increasing depth. The tumour cells in the upper dermis are well delimited and are round or cuboidal in shape. The spherical nucleus is found in the centre of the cell. The deeper parts of the tumours are composed of densely layered fusiform cells in band-like or whorled arrangements. Mitoses are rare. Necrotic areas may occur, but are uncommon. Usually the tumour cells are embedded in a dense network of collagen and argyrophilic fibres, often enveloping every cell. The tumours are comparable in certain respects to the human compound naevus. They reach about the size of a pea, are often verrucous, and frequently occur on the eyelid.

2. *Benign dermal melanomas*

(*a*) *Cellular type* (Fig. 38–42). These tumours are localized in the corium and subcutis and are separated from the epidermis by a more-or-less wide band of fibrous tissue. Here and there they extend to just beneath the epidermis. Junctional

activity is generally absent. There is usually a demarcation between the tumour and the epidermis, but there is often infiltration of the subcutaneous fat. Usually the tumours are heavily pigmented, but the pigment content may vary within the same tumour and among tumours. In heavily pigmented tumours, structural details are visible only after bleaching. A characteristic feature is densely packed fusiform cells in a striking, whorled arrangement. Often there are bundles of more-or-less densely layered, longitudinally arranged spindle cells. The dendritic nature of the tumour cells is disclosed in oedematous areas that can be seen especially near the surface, which is often ulcerated. Cell pleomorphism is generally absent, but mitoses may occur. According to the pigment content, macrophages (melanophages) in varying numbers can be seen. They are found predominantly in the vicinity of necrotic areas, which are not uncommon. Usually there is a considerable amount of collagen and argyrophilic fibres. These tumours may reach, or even exceed, the size of a walnut, and occur mainly on the extremities and the trunk.

(*b*) *Fibromatous type* (Fig. 43–46). This type is characterized by a band-like infiltration of heavily pigmented melanocytes into the upper corium. The tumour cells are long, dendritic, and usually arranged parallel to the surface epithelium. Similar dendritic cell nests can be found around the hair follicles, blood vessels, and cutaneous nerves. In the deeper parts of the tumours, there are fewer pigment-producing cells and a fibre-rich tissue of spindle cells, similar to a fibroma. Junctional activity is generally absent. Necrotic changes do not occur. These tumours reach about the size of a cherry and often occur on the trunk. They are frequently pendulous.

B. *Malignant melanoma* (Fig. 47, 48)

An important feature of these tumours is junctional and/or intraepithelial tumour growth, which is usually demonstrable unless the melanoma is extensively ulcerated. An exception is the dendritic and whorled type, in which these features cannot be seen. Intraepithelial tumour growth is proved by the occurrence of single atypical cells, cell nests, and band-like infiltration of the basal layers of the surface epithelium. Anaplasia with cell pleomorphism and varying degrees of mitotic activity are characteristic for all except the dendritic and whorled types. Necrosis is common but not constant. Invasive growth into lymph vessels and/or small veins is often seen. Some of these tumours appear to the naked eye to have no melanin, but, if a careful search is made for melanin, truly amelanotic melanomas are found to be rather rare. In tumours with little or no pigment, silver stain (Fontana) is very helpful when making a histological diagnosis, as it reveals at least some tumour cells that contain melanin. Malignant melanomas occur mostly in the skin of the extremities and in the oral mucosa. They may reach or exceed the size of an egg. Usually there is widespread ulceration of the surface epithelium, especially with oral melanomas. The latter often lead to destruction of the jaw.

1. *Epithelioid type* (Fig. 49–51). These melanomas are composed almost entirely of epithelioid cells in carcinoma-like tissue patterns. The tumour cells may be closely packed, thus resembling medullary carcinomas, or they may be arranged in lobules or trabeculae. The nuclei are generally large, with varying amounts of chromatin and possess one or more prominent nucleoli. Usually epithelioid melanomas are not excessively pigmented.

2. *Spindle cell type* (Fig. 52, 53). Melanomas of this type are almost entirely composed of typical bipolar spindle cells of varying sizes. The nuclei are mostly ovoid or elongated, usually with scanty chromatin and less prominent nucleoli. Mitoses are more numerous than in other types. The tumour cells are arranged in relatively uniform tissue patterns resembling spindle cell sarcomas or fibrosarcomas. In addition to tumours without any connective tissue fibres there are melanomas with a dense reticular network of collagen and argyrophilic fibres.

3. *Epithelioid and spindle cell type.* This is the most common type both in the skin and in the oral mucosa. Its histological appearance is far more variable than that of the foregoing types. Either spindle or epithelioid cells may predominate. Even in the same tumour large areas of either spindle cell or epithelioid tissue patterns may be seen.

4. *Dendritic and whorled type* (Fig. 54–56). Apparently this type does not occur in the oral mucosa. The tumour is composed of densely packed, always heavily pigmented spindle or dendritic cells arranged in whorled and band-like patterns. Cellular details are demonstrable only in bleached sections. There is a striking abundance of large, polyhedral or rounded, well-delimited pigment-containing cells (melanophages?), often outnumbering the smaller

tumour cells. The latter are dendritic but this feature can be recognized only in unbleached sections, being difficult to see after bleaching. They have rather small, chromatin-poor nuclei with indistinct nucleoli. Mitoses are absent or only sparsely visible. Striking anaplastic patterns as seen in the previously described types of malignant melanomas are usually absent. Therefore it is often very difficult, if not impossible, to distinguish this tumour from benign cellular melanoma. Large necrotic areas are common.

III. TUMOURS OF SOFT (MESENCHYMAL) TISSUES

Many soft-tissue tumours may be localized in the skin. These are classified according to the scheme shown in Part VIII (page 101).

IV. SECONDARY TUMOURS

Secondary tumours in the skin are very rare. Invasive growth of mammary tumours into the adjacent skin is sometimes encountered.