

hair follicles, often also the stratum spinosum^m shows a more or less heavy pigmentation, often patchy in distribution. The inner surface of the ear generally shows much less pigmentation. The sebaceous glands are fairly frequent, but small, and open into the numerous hair follicles present. Sweat glands are rare and very small.

III. SKIN CANCER OF ANGORA GOATS.

Before proceeding with the description of the cases observed, it is perhaps advisable to enumerate the various circumstances under which these tumours occur, the types of animals affected, and how the farmer deals with them.

OCCURRENCE.

Species. As pointed out, only Angora goats are susceptible to these types of tumour to this extent. Evidence gathered from farmers, as well as personal observations show that newgrowths of this description are practically unknown in the South African Native or Boer goat.

In sheep, skin tumours are occasionally met with on the head in various situations, such as on the ears, eye lids, cheeks, and forehead etc. Several such cases have already been examined at this Institute, and identified as spino-cellular carcinomata. Dodd (1923) describes the occurrence of skin cancer of the ear in Australian sheep, while Beatti attributes the carcinoma seen in Argentine sheep to injuries from thorn bushes.

SEX.

She-goats are by far the most commonly affected. Kapaters or castrated males only rarely, and then usually on a broken horn stump, ear, and elsewhere on the skin. Rams, on the other hand, have apparently never been observed suffering from cancer. It should be remembered that rams usually form only a small percentage

of the flocks. Whether this has actually anything to do with the apparent total absence of tumours in them, cannot at this stage be said, but it certainly seems that males, including kapaters, are much less susceptible to these tumours than females.

AGE.

Accurate figures cannot be given, but most of the cases observed were adult and aged animals. Although some "warts" were seen on quite young goats, these were merely of papillomatous nature.

FREQUENCY.

The estimated percentage occurrence of cancer amongst goats as stated by various farmers consulted, ranges from 1% to 5% of the flock yearly. Unfortunately, no statistics of any description are available to substantiate or refute these figures which are undoubtedly very rough estimates, and often on the high side. Even from the flocks inspected personally, it was found impossible to arrive at any definite figure, since the exact number of affected animals destroyed by attendants during the season could not be ascertained. It is very difficult to examine all the goats in the large and scattered flocks, to make sure that no early cases are missed. The cases actually studied were nearly all obtained from one owner, who estimate the percentage at 3%. This figure, however, seem unwarrantably high. The correct figure varies from flock to flock, and from year to year within the ranges mentioned above, and probably rarely reaches or exceeds 1%.

SEASON.

Tumours apparently develop at any time of the year although some farmers maintain that they are more frequent at, or after tapping time. In fact they firmly believe that the disease is transmitted by the ram at service, from affected she-goats, to the healthy. Although experiments

to prove this point could not actually be carried out, it seems very unlikely that this is the case (See contact experiments).

LOCALITY.

These tumours apparently occur all over the country where Angora goats are kept, even in the Transvaal under climatic conditions totally different to those of the Cape.

GENERAL APPEARANCE.

Under farming conditions the flocks are brought in at certain periods, e.g. for shearing, at kidding time, for dipping etc. This affords an opportunity of catching and handling each animal, so that it can be subjected to a more or less close inspection. In this way many of the tumours are detected while still fairly small. Tumours otherwise have to reach a certain size before they can readily be detected without handling the animal. As a rule, the first indication of the presence of a tumour is the soiling and matting together of hair around the perineum with slimy exudate and dirt. Tumours in other parts are also generally detected when they become ulcerated, start giving off soiling stinking, exudates and become fly struck. The general appearance of such tumours naturally varies greatly. The size may be anything from that of a pea up to 10 cms in diameter, either rounded and lobulated, or flattened like a great, raised, protruding ulcer. The parts affected in order of frequency are the perineum, ear, horn stump, udder and rest of skin. The first being by far the most commonly affected. Even in this situation the tumours have predilection seats, either the skin of the recess under the tail is affected, or the sides of vulva. Very often both are affected so that the growths run into each other. The tumours under the tail usually originate, and are attached to the skin above the anus, either in the centre or on to the side. The area of

attachment may remain small, so that the tumour as it grows becomes pedunculate and mushroom-like, or else on the other hand, the base may widen with the tumour and on account of necrosis or the action of fly larvae it may assume the form of a wide shallow, ragged ulcer with indurated, raised edges. From the usual starting point, i.e. the depth of the recess under the tail, the tumour grows as a moist, pinkish ^{mass} tumour, sometimes greyish to black, until it fills the whole space between the two lateral tail folds, which may even be pushed outward. It may then extend downwards, hanging over, or on either side of the anus, and even down to ^{the} vulva. The vulva tumours are more usually of the rodent ulcer type, partly covered with crusts and gradually widening and getting deeper, or bulging out to take on a cauliflower appearance. It seems to be a common property of these tumours, that as soon as they reach a certain size, they tend to become surrounded and covered by moist exudate, which forms a suitable pabulum for bacteria, and other organisms. This exudate tends to soil and mat the adjoining hair and contributes to considerable irritation. In some cases it appears to have a macerating influence on ^{the} lower lying, or in contact skin, often to such an extent as to give rise to apparently actual newgrowth or contact implantation. Blow flies are attracted to this region by the foul smell and moistness. They deposit their eggs on the tumour, with the result that the emerging maggots soon attack the tumour and eat their way into its substance, causing intense irritation and suffering to the animal. Apart from fly larvae the tumours often undergo loss of substance by the sloughing off of gangrenous tissue. Crusts, which form over them, are torn off mechanically, either accidentally by horning, etc., or by the animal itself, while scratching or biting itself on account of irritation. Haemorrhage is also very easily set up by the least traumatic action on the tumour. The early

stage of the tumour, i.e. from the time it begins developing until it becomes large enough to cause exudation and irritation etc., occupies a varying length of time, up to several months. During this period the animal seems to experience little or no inconvenience, and certainly remains in fair or even good condition according to the state of ^{the} parture. Such a small tumour, especially when in the depth of the tail recess can be easily overlooked, unless the tail is lifted and the part closely examined. In most cases the tumour grows only very slowly at first, and may even at times show considerable regression (gangrenous sloughs, maggots, etc.) On reaching a certain size, however, or for other unknown reasons, the disease may suddenly take a more rapid course. The animal stands apart from others, does not feed properly, and shows all the signs of intense worry and irritation, viz. constantly flicking its tail, stamping its feet, biting, horning and scratching the affected part, sometimes furiously, or else biting viciously other goats around the perineum. The animal seeks dark corners to lie in or creeps amongst other goats and usually lies with its head towards its perineum in an attempt to ward off flies. Condition is lost very rapidly, and the animal finally dies in a state of extreme emaciation and cachexia. In practice fortunately, affected animals are nearly always spared this cruel and slow torture, or at any rate it is curtailed. The farmer realises from experience that the condition is incurable. All cases are, therefore, destroyed, as soon as they come to his notice. In this way he is able to make use of the carcass while still in fair condition, and incidentally saves the animals from unnecessary suffering. She-goats affected with perineal tumours, if allowed to breed, naturally undergo terrible suffering and laceration of vulva during parturition. Apart from these humane and economic reasons, early culling is practised to minimise the chances

of carrying over the affection from diseased animals to clean ones.

The economic losses due to cancer of the goat in the past have been overshadowed by those due to other causes. The Veterinarians were mostly preoccupied with more important and urgent stock diseases. This probably is the reason why the condition has not been recorded before. Malignant ^{growths} ~~disease~~ in its various forms ^{their} ~~was~~ ^{are} well known and accepted as inevitable, or taken for granted, and as ^{they} ~~it~~ ^{are} known to be incurable, no further notice ^{is} ~~was~~ taken of ^{them} ~~it~~, beyond destroying the affected animals. Attempts at treatment have been repeatedly tried by the more enterprising owners, especially where the more valuable animals ^{are} were concerned. ~~Applications of~~ A paste made up with Cooper's Arsenical dipping power ^d, is said to have some beneficial effect when applied in the early stages. Other drugs and herbs have also been tried with varying and doubtful results. Surgical removal in the crudest form is practised in some rare cases of cancer of the ear, by the simple process of cutting the ear off above the tumour. A few "permanent" cures were effected in this way. Such cases, however, are few and far between, especially in late years as most farmers prefer to kill off all affected animals. They claim that this is directly responsible for the undoubted reduction in incidence of cancer lately.

There are also some who maintain that since the advent of ^a more modern and rational system of farm management, i.e. allowing the animals free range in vermin-proof camps, instead of herding and kraaling, coupled of course with the practice of culling, the occurrence of cancer has been materially reduced.

MATERIAL COLLECTED.

The material ^{studied} ~~worked on~~ consisted of:

- (1) Seven tumours, early stages, removed surgically from affected animals on the owner's farm (Series 7256). This incidentally afforded an opportunity of visiting the flocks under actual farming conditions, and of gathering first hand information. Other information was obtained from various progressive Angora goat farmers by circulating a questionnaire^e dealing with some of the most obvious aspects of this disease.
- (2) 15 Affected animals obtained from various sources of which 11 were from the ~~same~~ owner referred to above. These animals were consigned to this Institute and kept in stables and later together with some 30 experimental animals in a small paddock. Some were used for transmission and various other experiments, while others were kept for the observation of the tumours in their various stages of development. In nearly all cases material was collected for histological examination. The description of each case, including the clinical observations, post mortem and histological results, will be found in protocol form ^{at the end of this paper.} ~~in the appendix.~~

The following table gives a summary of the cases, ~~in tabular form for comparison.~~

TABLE OF CASES FOR COMPARISON.

Case	Sex	Age	Situation	Diagnosis	Metastases	Pigment	Maggots	Remarks.
14771	♀	F.m.	perineum	Mixed sp. & bas. c. ca.	-	xx	-	Died probably poisoning.
14772	"	Aged	anus	Bas. c. ca.	-	-	-	Tumour removed. R
14773	"	<i>Aged</i>	perineum	Mixed bas. & sp. c. ca.	xxx	xxx	-	Killed.
17293	"	Aged	perineum	Sp. c. ca.	xx	-	xxx	Died.
17294	"	"	anus	Mixed sp. & bas. c. ca.	-	-	-	Tumour removed, surgically. R
17296	"	"	horn stump	Bas. c. ca.	xxx	xxx	xxx	Killed in extremis.
17297	"	"	vulva	Bas. c. ca.	xxx	xx	xxx	Died.
17298	"	"	vulva	Sp. c. ca.	xx	-	xx	Died.
17299	"	"	ear	Bas. c. ca.	-	xxx	xx	Tumour removed surgically. R
21957	"	"	perineum	Mixed sp. & bas. c. ca.	?	-	-	Biopsy for diagnosis.
7256A	"	"	anus	Bas. c. ca.	-	x	-	Tumour removed surgically. R
7256B.	"	4 t.	vulva	Bas. c. ca.	-	xxx	-	Tumour removed surgically. R
7256C	"	Aged	anus	Mixed bas. & sp. c. ca.	-	xx	-	Tumour removed surgically. R
7256D	"	F.m.	Anus	Bas. c. ca.	-	x	-	Tumour removed surgically. R
7256E	"	6 t.	neck	Bas. c. ca.	-	-	x	Tumour removed surgically. R
7256F	"	Aged	anus	Sp. c. ca.	-	-	xxx	Tumour removed surgically. R
14770	"	F.m.	anus	Clinically Bas. c. ca.	-	-	xxx	Tumour eaten up by maggots. R
17292	♂	F.m.	horn stump	Clinically Bas. c. ca.	-	-	xxx	Died. No material collected R
17300	♀	2 t.	fore head	Papilloma	-	-	-	Spontaneous disappearance. R
17301	"	2 t.	face	Papilloma	-	-	-	Spontaneous disappearance. R
9983	"	<i>Aged.</i>	anus	Mixed sp. & Bas. c. ca.?	-	-	-	Died.
7256G	"	3 t.	vulva	Chron. pur. dermatitis	-	-	-	Died. Early stage tumour.
14505	"	Aged	vulva	-	-	-	-	Under observation, see protocol
15690	"	"	anus	-	-	-	-	Under observation see protocol.

Bas. c. ca. = Basal cell carcinoma.
 Sp. c. ca. = Spinous cell carcinoma.
 F.m. = full mouth.
 2 t. = two tooth.
 R = Recovered

THE CASES STUDIED.

From the foregoing table, it will be seen that 24 animals are included, although they did not all suffer from true cancer. Nos. 14770-14773 were received here on or about ^{the} 20th August 1926, but were not taken over by the writer until the 17th June 1927. A further 10 goats Nos 17292-17301 were received from the same source on the 15th June 1927. They were selected and sent up by the owner as specimens of cancer cases. No. 17295 is not included in the table as on arrival no tumour could be found on it, neither did any develop subsequently. Nos. 17300 and 17301 were young 2 tooth animals, and had papillomata, which subsequently disappeared. It is stated that "warts" by being continually scratched and injured may develop into cancer, but it is doubtful whether these would have become true cancers under any circumstances, The "warts" that the farmers may have seen turn to cancer are probably not ordinary papillomata, but cancerous or precancerous growths. No. 17292 died on arrival, but unfortunately no material was collected for sections, as it was not realised in time that the gangrenous tissue around the broken horn stump might be of the nature of a tumour. It is quite probable that this case was similar to 17296 No. ~~17297~~ ²¹⁹⁵⁷ received on ^{the} 17th November 1928, from a different locality, was suffering from a typical cancer ^c of the perineum. The seven specimens marked 7256A to ⁷²⁶⁶ G are all tumours removed ^{the} on 20th August, 1927, during the course of a visit to the farm from which the first two lots originated. These tumours had developed, or rather become apparent to casual inspection, since the previous series (17292-17301) had been culled from the flocks. It may be taken, therefore, that they were still in the earlier stages of development, a point which seems supported by their relative small size, and microscopical appearance generally. The object of this visit was to study the local conditions, collect material for microscopical examination and incidentally note the

curative effects of surgical removal. Nos. 9983, 14505 and 15690 were picked out from the available experimental goats on account of peculiarities which might throw some light on the mode of development of the tumours. No. 9983 had a small pea size protuberance under the tail to start with and this eventually grew to a flat excrescence a couple of c.m. in diameter. The histology of this growth seems to explain the origin of this type of neoplasm to some extent. No. 14505, which accidentally received a traumatic laceration of the vulva, was left untreated and kept under observation to see whether the chronic inflammation would lead to the beginning of a new growth. Up-to-date no evidence of this can be seen. No. 15690 had a peculiar fringe of small, short, skin outgrowths under the tail, on which caked balls of secretion, dirt etc. accumulated and hung down. These outgrowths have so far made no progress and are apparently malformations of the skin and not at this stage to be regarded as tumours, see Fig. Out of the 24 animals included in the table, Nos. 17300, 17301, 14505, and 15690 are only of interest inasmuch as the lesions noticed might have formed a starting point for cancerous growths. Nos. 14770, 17292, 72560 and 9983, cannot be taken into account as no material was examined microscopically from the first two, and the diagnosis of the last two is doubtful. No. 9983 and also 14772, show very interesting changes, which it is believed might explain the earlier developmental stages of the tumours in question.

This leaves a total of 16 goats in which epitheliomata of various types were examined.

The diagnoses arrived at are given in the table for comparison and the microscopical findings in the protocols at the end of this paper.

These sixteen cases are all females. The only castrated male, (Kapater 17292), was excluded on account of

lack of histological evidence as to the nature of the growth. Their ages vary & the youngest being 4 tooth, while the majority are classed as full mouth and aged. The latter term includes those in which the incisors are worn down to mere rounded stumps on the gums.

The tumours were distributed as follows: 13 at perineum, one on a broken horn stump, one on the ear and one on the neck. By perineum is meant the short haired skin around anus and vulva. These two organs are not considered separately, since in our experience both may be affected at once. Tumours have been seen extending from the one to the other during the course of their development, e.g. 14771 and 17293.

As regards the nature of the various neoplasms, three had more or less definite cancrioid tendencies and can be called spinocellular carcinomata. Eight ~~had~~^{showed} no keratinisation, and are, therefore, classed as basal cell carcinomata, while the remaining five are ~~mixed~~^{combined} forms, either containing well demarcated areas of either type, or else a more or less ill defined structure. These still have some of the characters of a basal cell carcinoma, but some cells ^(somewhat) show degeneration, swelling and keratinisation, resembling those seen in cancrioids. It must be stated, however, that the above grouping, which is arbitrarily based on the one or two characteristics, namely, keratinisation and morphology of cells, is very unsatisfactory, since there is no sharp distinction from one to the other, but rather as it were a graded scale of transition from the round celled, sarcoma-like, basal cell tumour on the one hand, to the pearl-nest forming cancrioid on the other.

Krompecher in his classification of Basaliomas of course does make provision for keratinising Basal cell carcinoma, which he calls Carcinoma basocellulare parakeratodes. Metastases were only noted in four of the cases.

Two of these 17293 and 17298 were in the supramammary lymphatic glands only, from primary perineal cancroids. The remaining two cases were from non-keratinising epitheliomata, i.e. ~~identified as~~ basal cell carcinoma.

No. 17296 with growth on the broken left horn stump, showed metastases in all the lymphatic glands of the head and neck on the left side only, as far down as the pre^Scapular~~s~~ & liver, see Fig. /8 The other 17297, also had extensive metastases. The lymphatic glands affected were the supramammary on both sides, sublumbar and mediastinal, and in addition the kidneys, pancreas, liver, heart and lungs, see Fig.

It is evident thus that malignancy is independent of the hornifying properties of these neoplasms. We have, for instance, several other cases of mixed forms, some of which were observed for considerable period of time, where metastases did not occur. Pigmentation (melanin), appears to play an important role in these tumours. It will be seen that a few had a pitch black colour, due to presence of large amounts of melanin, which was formed in the growth itself. Some had varying quantities of this pigment, which was sometimes localised in certain parts only, while others again, seemed to be devoid of it altogether.

BACTERIOLOGY.

The bacteriological aspect of these tumours was investigated only very superficially. On account of the lack of facilities and time, it was felt that this subject was better left over for the time being. There are certainly many interesting points which are well worth investigating by a bacteriologist or protozoologist; for instance, the role played by bacteria and spiral organisms in the development or extension of the tumours. The smear preparations made from the scrapings of the surface of the tumours showed an abundant and varied bacterial flora. This could, however, be expected from the open nature of the lesions. An

addition also, many cases showed the presence of numerous spirochaetes and spirilla. These were at first regarded with suspicion, in view of the alleged transmissibility of the condition at tugging time. Attempts at transmission, e.g. by close contact of affected animals with non affected ones, rubbing of infected material into the mucous membrane of the vulva, scarification, and injection with suitable material, all proved unsuccessful. These spirochaetes are usually to be found in the moist exudate around the tumours. They appear to be always associated with a type of bacterium seen in fusiform or beaded-chain formation. They correspond very closely to those described by Tunnicliffⁱ and others, and found in Vincents agina, otitis media, and adenoids in man. It is, of course, well known too, that types of spirochaetes^{are} often found in ulcerating open sores in man and animals generally. In pigs in this country, they are often found in large abscesses, of which they are believed to be the cause. Peculiarly enough, the spirochaetes found on these tumours, occurred apparently only in the goats which had been on the premises of this Institute for some time. None could be found on the newly introduced cases nor on those examined on the farm of origin (7256 series). Furthermore, in those cases where material from swabs of the tumours was injected subcutaneously near the anus, an abscess^{usually} developed and burst, leaving an open wound in which spirochaetes were often found in large numbers. In spite of this such a wound invariably healed up rapidly.

From the foregoing it is concluded, therefore, that the spirochaetes observed were only part of the many contaminating saprophytes growing under the favourable conditions produced around the ulcerating tumours, and that they were not directly the cause of the tumours. This of course, does not preclude the possibility of secondary influence on the further development or spreading of the growth once