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Morphology of the lymph drainage of the head, neck, thoracic limb and thorax of the goat (Capra hircus)

Kusmat Tanudimadja
Iowa State University

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Morphology of the lymph drainage of the head, neck, thoracic limb and thorax of the goat (*Capra hircus*)

by

Kusmat Tanudimadja

A Dissertation Submitted to the
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For the Graduate College

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1973

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DEDICATION

Dedicated to the memory of my father

Suhanda Tanudimadja

INTRODUCTION

The world goat population has been estimated to be 377 millions (FAO Production Yearbook, 1967, cited by French, 1970). By using the data available from the above source, French (1970) calculated that the overall ratio of the goat to the sheep and cattle was 2.7:1 and 2.8:1, respectively.

Goats are multipurpose animals, producing meat, milk, skins and hair. Their primary function is meat production, although in temperate countries milk production has become of greater importance; skins are a valuable by-product, especially in those countries with a large population of goats (Devendra and Burns, 1970).

Lindahl (1968) emphasized the role of the dairy goat in the world food supply at the 64th Annual Meeting of the American Dairy Goat Association at Bethesda, Maryland; he also indicated that the unique role of the dairy goat is the ability of the species to exist and produce where other milk producing animals cannot.

In some countries, for example Ghana, there is a preference for goat meat (Jollans, 1959, cited by Skinner, 1972) and recently 48,000 feral goats have been slaughtered in New Zealand for export to Ghana, Cyprus, Fiji, the West Indies and Italy (Kirton, 1969, cited by Skinner, 1972).

The grazing behavior of goats, i.e., browsing and their habit of stripping bark, can be utilized to control bush and

shrub growth, therefore, can be used in combination with cattle in the bushveld. However, one should consider the correct stocking rate to prevent overgrazing. Experiments in South West Africa have shown that low growing bushes and shrubs which are not normally eaten by cattle, are utilized by goats. They devour the lower branches and as a result grass grows right up to the trunks of trees where cattle then are able to reach it (Skinner, 1972).

The increased importance of the goat in the world food supply was expressed in the Second International Conference on Goat Breeding in Tours, France (July 17-19, 1971). Twenty-five countries and 200 persons participated in this conference and a total of 41 papers were presented under three themes: economy of production, nutrition and selection. A significant feature of this conference, unlike the London meeting in 1964, was the active participation of delegates from several countries in the tropics. A standing committee was formed from South East Asia, India, Middle East, Israel, Europe, North and South America in order to ensure that the future conferences of this nature will be held and therefore promote the value of the goat (Commonwealth Agricultural Bureaux, 1971).

There has been increasing interest in the goat as a research animal and various workers pointed out several advantages of this species. They are inexpensive and

tolerate wide variation of temperature. Therefore their housing needs not be elaborate, except where temperature control is critical in the project under study. They are content to live in almost any surroundings, are easily handled and relatively inexcitable. Their larger size makes it easier to perform intricate surgical operations than is possible in the guinea pig, mouse and rat (Magilton and Getty, 1969). Becket et al. (1971) utilized the goat in their investigation on the physiology of the external genitalia (penis).

Because of increasing value of the goat the present study on the morphology of lymph drainage of the head, neck and thoracic limb, and the thorax, was felt necessary. The importance of the basic knowledge of the lymphatic system has been long recognized by scientists as well as by Federal Meat Inspection. Thus, in Circular 866 of the U.S.D.A. it is noted that "person engaged in meat inspection should have a thorough knowledge of the lymphatic system of animals, the flesh of which is used for food" (United States Department of Agriculture, 1951, cited by Saar and Getty, 1961-1962). The basic knowledge of the lymphatic system of the goat is undoubtedly important with regard to physiological, pathological and clinical purposes as well as milk and meat hygiene.

Very little information to date is available in the

literature[1] regarding a comprehensive macroscopical study of the lymphatic system of the goat (Schrauder, 1934, 1949; Iwanoff, 1947-1948; Karbe, 1965; Nickel and Wissdorf, 1966; and Ozgüden, 1967). Baum (1912) described in detail the lymphatic system of the ox ("Das Lymphgefässsystem des Rindes") which becomes the source of various existing textbooks in the related fields (Martin, 1919; von Ostertag, 1932; Ellenberger and Baum, 1943; Sisson, 1938; and Sisson and Grossman, 1953).

Grau (1933, 1934) studied the lymphatic system of the sheep to investigate the species differences amongst domestic ruminants. He determined some differences while working on the lymphatic system of the skin and muscles of the thoracic limb. Ozgüden (1967), however, did not observe worthwhile differences between the Angora goat and Karaman sheep.

Regional description of the lymphatic system has been adequately described by Montané and Bourdelle (1917) and Habel (1970) in the ruminants, McLeod (1958) and Dyce and Wensing (1971) in the ox and May (1970) in the sheep.

With respect to the nomenclature the General Assembly of the World Association of Veterinary Anatomists (1967) adopted terms, published as the Nomina Anatomica Veterinaria

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[1]Medlars and Medline Services, computer assisted literature searches of the National Library of Medicine, were incorporated in the bibliographic search.

(1968) and further amended in the World Veterinary Anatomists Congress in Mexico City (1971), have been used, whenever possible. The terms pertaining to the lymphatic system of the region under study have been translated into their English equivalent, if available, otherwise the Latin form has been retained.

It is hoped that the present study will contribute to better understanding of newer nomenclature, and will be helpful for better morphological knowledge of the lymphatic system of the domestic ruminants, in this instance, the increasingly important species--the goat.

REVIEW OF LITERATURE

Very little information concerning the macroscopical studies of the lymphatic system of the goat was available in the existing literature (Iwanoff, 1947-1948; Ozgüden, 1967). Therefore, a comprehensive review of the literature on the lymphatic system of other domestic ruminants (ox and sheep) was attempted in making a comparative study on the basis of present investigation, thus bringing out the species differences, if any, between domestic ruminants.

The first systematic study amongst domestic ruminants could be found in Baum's (1912) classical work "Das Lymphgefässsystem des Rindes". This standard work has partly or completely been incorporated in the textbooks by many authors (Martin, 1919; von Ostertag, 1932, 1934; Sisson, 1938; Grau, 1943; and Sisson and Grossman, 1953).

Grau (1933, 1934) studied the lymphatic system of the skin and muscles of the thoracic limb, respectively, in the sheep to determine the species differences amongst domestic ruminants. He was able to demonstrate that differences of the lymphatic system between the sheep and ox did exist, though Ozgüden (1967) could not establish worthwhile differences between the native Angora goat and Karaman sheep.

Iwanoff (1947-1948) studied the anatomy and topography of the lymph nodes and large lymph vessels in five goats. He stated that some lymph nodes, usually present in the ox

(Baum, 1912), were absent in the goat.

It should be stressed that early studies on the lymphatic system (Baum, 1912; Postma, 1928; Grau, 1933, 1934; Iwanoff, 1947-1948; Ozgüden, 1967) were conducted in non-living animals. Most (1927) suggested the necessity of further research on the lymph flow in living animals. Postma (1928) hypothesized that differences of lymph flow must exist between the dead and living animal. This has been demonstrated by Egehøj (1934a, b, c) and Sandberg (1934) in their studies to reevaluate Baum's (1912) classical results on the lymph flow in the ox.

Saar and Getty (1962-1963, 1964a, b, c) investigated the lymphatic system in living (anesthetized) pig to reevaluate the results of previous workers.

It appeared that the terminologies of the various lymph nodes of the specific regions under investigation used by various authors were different. Therefore, a review of same has been presented in Tables 1 through 3, and a comparison has been attempted with the newly adopted terms of the Nomina Anatomica Veterinaria (1968).

No attempt has been made to update the nomenclature of the lymph nodes in this section, and the original terms used by respective authors have been retained. Pertaining to the other structures of the body the equivalent terms existing in the current literature were put in parentheses

after their originals.

The following abbreviations were used throughout the literature review:

Lgl. = lymphoglandula or lymphoglandulae;

lgl. = lymph or lymphatic gland;

lgls. = lymph or lymphatic glands;

Ln. or ln. = lumphonodus or lymph node;

Lnn. or lnn. = lymphonodi or lymph nodes;

N. l. = nodulus lymphaticus;

Nn. ll. = noduli lymphatici;

Lc. = lymphocentrum.

The terms afferent and efferent vessels were frequently substituted by their equivalent afferent(s) and efferent(s), respectively.

The Lymph Nodes and Lymph Vessels of the Head of the Ox

The terminology of the lymph nodes of the head as used by various research workers has been given in Table 1 and has been arranged in chronological order.

The lymph nodes of the head

According to Baum (1912), the lymph nodes of the head consisted of the Lgl. parotidea, Lgl. mandibularis, Lgl. retropharyngeae, Lgl. pterygoidea and Lgl. hyoideae.

Table 1. Terminology applied to the lymph nodes of the head region of domestic ruminants

Group	Chauveau and Arloing, 1891 (ruminants)	Baum, 1912 (ox)
1	--	Lgl. parotidea
2	Submaxillary or subglossal glands	Lgl. mandibularis
3	Pharyngeal or guttural glands	Lgl. retropharyngeae
		Lgl. retropharyngea medialis
	--	Lgl. retropharyngea lateralis
4	--	Lgl. pterygoidea
5	--	Lgl. hyoideae
	--	Lgl. hyoidea oralis
	--	Lgl. hyoidea aboralis

	Martin, 1919 (ruminants)	Leighton, 1927 (ox)
1	Lgl. parotidea	Other lgl. lying close to the parotid salivary glands
2	Lgl. mandibularis	Submaxillary lgl.
3	Lgl. retropharyngeae	--
	Lgl. retropharyngea medialis	Upper cervical lgl.
	Lgl. retropharyngea lateralis	Included retropharyngeal lgl.
	--	--
4	Lgl. pterygoidea	--
5	Lgl. hyoideae	--
	--	--
	--	--

	Godbille, 1915 (ox, sheep)	Montané and Bourdelle, 1917 (ruminants)
1	Parotid lgl.	Ganglion parotidien
2	Maxillary or sub-glossal lgl.	Ganglions maxillaires or sous-glossiens
3	Retropharyngeal or sub-sphenoidal or hyoid lgl. --	Ganglions pharyngiens --
4	--	--
5	-- -- --	-- -- --

	von Ostertag, 1932 (ox)	Sisson, 1938; Sisson and Grossman, 1953 (ox, sheep)
1	Ln. parotideus	Parotid lgl.
2	Ln. mandibularis	Mandibular lgls.
3	Lnn. retropharyngei Ln. retropharyngeus medialis Ln. retropharyngeus lateralis --	- Suprapharyngeal or retro-pharyngeal lgls. Atlantal lgl. Parapharyngeal lgl.
4	Ln. pterygoideus	Pterygoid lgl.
5	Lnn. hyoidei -- --	Hyoid lgl. Anterior hyoid lgl. Posterior hyoid lgl.

Table 1 (Continued)

Group	Grau, 1943 (ruminants)	Edelmann et al., 1943 (ox)
1	Ln. parotidicus	Parotid lgl.
2	Ln. mandibularis	Submaxillary lgl.
3	--	Superior or retropharyngeal lgl.
	Ln. pharyngicus medialis	--
	Ln. pharyngicus lateralis	--
4	Ln. pterygoideus	--
5	Lnn. hyoidei	--
	Ln. hyoideus oralis	--
	Ln. hyoideus aboralis	--

	Somers, 1951 (ox, pigs, sheep)	von Ostertag and Schönberg, 1955 (ox)
1	Parotid lgl.	Ln. parotidicus
2	Mandibular lgl.	Ln. mandibularis
3	--	Lnn. retropharyngici
	Suprapharyngeal lgl.	Ln. retropharyngicus medialis
	Atlantal lgl.	Ln. retropharyngicus lateralis
4	--	--
5	--	--
	--	--
	--	--

	Webb, 1944 (domestic animals)	Iwanoff, 1947-1948 (goat)
1	Parotid ln.	Ln. parotidicus
2	Mandibular ln.	Ln. mandibularis
3	Retropharyngeal lnn.	Lnn. retropharyngici
	Medial group	Lnn. retropharyngici mediales
	Lateral group	Lnn. retropharyngici laterales
4	Pterygoid ln.	--
5	Hyoid lnn.	--
	Oral	--
	Aboral	--

	Dobberstein and Hoffmann, 1964 (ox)	Schwarze and Schröder, 1964 (ruminants)
1	Nn. ll. parotidiei	Lnn. parotidici
2	Nn. ll. mandibulares	Lnn. mandibulares
3	Nn. ll. retropharyngei	Lnn. retropharyngici
	Nn. ll. retropharyngei mediales	Lnn. retropharyngici mediales
	Nn. ll. retropharyngei laterales	Lnn. retropharyngici laterales
4	--	--
5	--	--
	--	--
	--	--

Table 1 (Continued)

Group	Thornton, 1968 (ox)	Nomina Anatomica Veterinaria, 1968 (ruminants)
1	Parotid lnn.	Lnn. parotidea
2	Submaxillary lnn.	Lnn. mandibulares
3	Retropharyngeal lnn.	--
	Internal retropharyngeal lnn.	Lnn. retropharyngei mediales
	Lateral retropharyngeal lnn.	Lnn. retropharyngei laterales
4	--	Ln. pterygoideus
5	--	--
	--	Ln. hyoideus rostralis
	--	Ln. hyoideus caudalis

	Koch, 1970 (ox, sheep)	May, 1970 (sheep)
1	Ln. parotidicum	Ln. parotideus
2	Ln. mandibularis	Lnn. mandibulares
3	-- Ln. retropharyngicus medialis Ln. retropharyngicus lateralis	-- Lnn. retropharyngei mediales Lnn. retropharyngei laterales
4	--	--
5	-- -- --	-- -- --

The Lgl. parotidea (Baum, 1912), one on each side of the head, measuring 6.0-9.0 cm long, 1.0-3.0 cm wide, and 0.75-1.0 cm thick, was situated close and ventral to the temporomandibular joint, so that approximately one half of the node was still covered by the parotid gland. The other half, however, extended cranially and was located subcutaneously on the mandibular border and the masseter muscle, being directly covered by the skin, superficial fascia and some fat. Medially, it was related to the large vessels (viz. the external carotid artery and maxillary vein), and the nerves (viz. dorsal buccal branch of the facial nerve and the superficial temporal nerve). The Lgl. mandibularis, measuring 3.0-4.5 cm long, 2.0-3.0 cm wide, and 1.0-1.75 cm thick, was situated approximately between the incisura vasorum facialium and the angle of the mandible. The second and smaller node, if present, was located caudal or dorsomedial to the larger one. Dorsally the node was related to the facial artery and vein, the ventral buccal branch of the facial nerve and the parotid duct. The Lgl. retropharyngeae, which consisted of the Lgl. retropharyngea medialis and lateralis, were generally located on the dorsal wall of the pharynx between the latter on one side and the base of the skull and the flexor muscles of the head on the other. The Lgl. retropharyngea medialis, usually a large node, measuring 3.0-6.0 cm long, 2.5-4.0 cm wide, and 1.5-2.0

cm thick, was situated medial to the stylohyoid on the pharyngeal musculature, between the latter and the flexors of the head; its location was variable. In some cases it extended caudally beyond the stylohyoid resting on the medial face of the digastricus muscle; in other cases it extended cranially and reached the levator veli palatini muscle and yet, partly, it was situated medial to the pterygoideus muscle. Usually one (sometimes two) small node was present. The Lgl. retropharyngea lateralis, embedded in fat, measuring 4.0-5.0 cm long, 2.0-3.5 cm wide, and 0.75-1.25 cm thick, was located medial to the caudoventral border of the mandibular gland, being covered partially or completely by same. At the same time, the node was, partly or completely, located caudoventral to the origin of the digastricus muscle, ventromedial to the free border of the atlas and directly dorsal to the common carotid artery. In about one half of the cases Baum (1912) found, in addition to the large node, 1-3 smaller lymph nodes, thereby constituting the Lgl. retropharyngeae laterales. The smaller nodes were located either caudal or ventral or cranial to the large node or slightly farther from the latter. The Lgl. pterygoidea was situated on the ventral face of the origin of the pterygoideus muscle, caudomedial to the maxillary tuber and rostral to the cranial border of the ramus of the mandible. The node was present in most cases

(out of 19 specimens Baum found 11 times on both sides of the head, 3 times on either the left or the right side, and 5 times it was absent). The Lgl. hyoideae consisted of the Lgl. hyoidea oralis and the Lgl. hyoidea aboralis. The former was located on the lateral face of the thyrohyoid bone, at the insertion of the stylomastoideus muscle, while the latter was situated between the lateral face of the angle of the stylohyoid bone and the occipitohyoideus muscle. The Lgl. hyoideae were inconstant nodes, the Lgl. hyoidea oralis being found in 6 out of 28 specimens, while the Lgl. hyoidea aboralis occurred in 4 cases out of 20, and in one instance found on both sides of the head, twice only on the left, and once there were two nodes.

Godbille (1915) recognized only three lymphatic glands on each side of the head. The first was the parotid, situated immediately under the parotid gland and against the caudal face of the condyle and the synovial capsule of the temporomandibular joint. The second was the maxillary or sub-glossal gland, situated inside the border of the mandible, caudal to the masseteric groove, where the facial vein and artery were lodged. The third was the retropharyngeal gland, lying within the dorsal part of the stylohyoid under the longus capitis muscle. This gland was also named the subsphenoidal or hyoid gland. According to Godbille, there

was also a second smaller pharyngeal gland, situated cranial to the preceding larger gland.

According to Montané and Bourdelle (1917), the ganglion parotidien was well developed in the ruminants, especially in the sheep and goat. It was kidney-shaped, flattened, and was situated below the temporomandibular joint between the masseter and the parotid gland. Its cranial border became thinner, slightly projecting cranial to the latter, and covered the emergence of the transverse facial vessels and nerve. The ganglions maxillaires or soux-glossiens were located more caudal than in the horse; they lay between the sternomandibularis muscle and the facial vein, on a level of the caudal border of the mandible outside the mandibular gland. They consisted of one to two considerably large grey nodes and one to two hemal lymph nodes. The ganglions pharyngiens, rather large voluminous lymph nodes, were caudal face of the pharynx, and consisted of two to three grey nodules. They were continued by a chain of variable number of hemal lymph nodes.

in his textbook, Martin (1919) referred to the description of the lymph nodes of the head to Baum's monograph (1912) on the lymphatic system of the ox. According to Leighton (1927), in the head of the ox there were the submaxillary lymphatic glands, and other lymphatic glands, situated close to the parotid gland, being partly in

relationship to the lobules of that gland, behind the articulation of the jaw. The retropharyngeal glands, according to Leighton, were included into the upper cervical lymphatic glands.

von Ostertag (1932, 1934) and Grau (1943) described the lymph nodes of the head of the ox concordant with Baum (1912), except that von Ostertag used the term Ln. (Lymphonodulus) and Lnn. (Lymphonoduli), and Grau the term Ln. (Lymphonodus) and Lnn. (Lymphonodi).

Sisson (1938) and Sisson and Grossman (1953) listed seven lymph glands in the head of the ox. These were: parotid, mandibular, suprapharyngeal, parapharyngeal, atlantal, pterygoid and hyoid lymph glands. According to these authors the parotid lgl. was located on the caudal part of the masseter muscle and was partly covered by the dorsal part of the parotid gland. In exceptional cases it was completely covered by the parotid gland. It was deeply related to the maxillary and superficial temporal vessels and the superficial temporal nerve. In some cases there were two smaller glands instead. The mandibular lgls. were usually two in number, one on each side of the head. Each gland was situated between the sternomandibularis muscle and the ventral part of the mandibular gland, and usually related dorsally to the facial vein. The suprapharyngeal lgls., usually one on each side of the head, were located

medial to the stylohyoid bone, and between the pharynx and the longus capitis muscle. In some cases an additional gland was present. The small parapharyngeal lgl. was situated on the lateral wall of the pharynx, under cover of the mandibular gland or at its caudal border. It was ventral to the common carotid artery and the atlantal gland. The atlantal lgl. was situated ventral to the wing of the atlas, on the cleidomastoideus tendon, and partly under cover of the mandibular gland. It was related ventrally to the common carotid artery. One or more small lymph glands might occur near the large constant one, and small hemal lymph nodes were commonly present here. The description of the pterygoid and hyoid lgls. was concordant to that of Baum (1912).

According to Edelmann et al. (1943), the parotid lgl. was situated on the medial face of the parotid gland, and in the ox a special large gland, which extended over the maxillary border of the parotid gland and partly lying on the masseter muscle. The submaxillary lgls. were situated superficially in the mandibular space at the angle of the mandible; sometimes there were two small nodes. The retropharyngeal lgls. were located at the base of the cranium, in the dorsal part of the pharyngeal cavity, forming two large bodies. Also Edelmann et al. called these glands the superior cervical lgls.

Webb (1944) stated that the parotid ln. was situated ventral to the temporomandibular joint on the border of the mandible, covered partly or wholly by the parotid gland. The mandibular ln., also commonly known as maxillary, was found beneath the cutaneus faciei muscle close to the ventral border and angle of the mandible. The retropharyngeal lnn., according to Webb, consisted of medial and lateral groups. The medial retropharyngeal ln. was found in the loose fascia above the pharynx, medial to the stylohyoid bone; the lateral retropharyngeal ln. was situated in the vicinity of the atlantal fossa, where it was partly or wholly covered by the parotid gland. In the ox the number of the nodes in the individual groups was reduced to one, two or three, one of them was usually by far the largest. All nodes were represented with possible addition of three small lymph nodes, the oral hyoid, aboral hyoid and pterygoid. The location of these nodes was in great part concordant with Baum (1912). Webb reported further that the parotid and lateral retropharyngeal lnn. were large.

According to Somers (1951), the term "Cervical lymph glands" as used by the Federal Meat Inspection Service included the parotid, mandibular, suprapharyngeal, parapharyngeal and atlantal lymph glands. The parotid lgl., according to Somers, was situated on the caudal border of

the masseter muscle. It was partly embedded in the parotid gland, lying about 2.5 cm cranial and ventral to the external acoustic meatus. The mandibular lgls. were located in the ventral portion of the mandibular space, between the medial surface of the mandible and the mandibular gland, about 5.0 cm cranial to the point where the ventral border of the mandible curved dorsally and above the cranial attachment of the sternomandibularis muscle. Occasionally two glands were found lying very close to each other. The suprapharyngeal lgls. were situated at the base of the cranium just dorsal to the pharynx, lying close together on each side of the median line between the cornu of the hyoid. The atlantal lgls. were located ventral to the wing of the atlas and partly under cover of the mandibular gland. They were related ventrally to the common carotid artery. Small hemal lymph nodes were observed in the vicinity.

Dobberstein and Hoffmann (1964) divided the lymph nodes of the head into superficial and deep groups. The former consisted of the Nn. ll. parotidei and Nn. ll. mandibulares, while the latter comprised the Nn. ll. retropharyngei. The Nn. ll. parotidei were situated close and ventral to the temporomandibular joint beneath the cranial border of the parotid gland, being partly embedded in the latter. The Nn. ll. mandibulares were located at the caudal

part of the mandibular space between the skin and the mylohyoideus muscle. The Nn. ll. retropharyngei were situated on the dorsal aspect of the pharynx.

According to Brandly et al. (1966), the parotid lnn. were situated at the dorsorostral border of the parotid gland, being partly embedded in the gland and partly lying on the masseter muscle about 2.5 cm cranial and ventral to the external acoustic meatus. The mandibular lnn. were located superficially in the ventral portion of the mandibular space, between the medial face of the mandible and the mandibular gland, about 5.0 cm rostral to the point where the ventral border of the mandible curved abruptly dorsally and above the cranial attachment of the sternomandibularis muscle. Occasionally two nodes were observed lying very close to each other. The suprapharyngeal lnn. were located at the base of the cranium just dorsal to the pharynx, lying close together on each side of the median line, between the cornu of the hyoid bone. These nodes averaged 5.0 cm in length.

Stokoe (1967) stated that the parotid lqls. were situated on the caudal part of the masseter muscle, partly covered by the parotid gland. The mandibular lqls., one on either side, were located between the sternomandibularis muscle and the ventral part of the mandibular gland. The two suprapharyngeal lqls. were situated medial to the

stylohyoid bone and the longus capitis muscle. The parapharyngeal lgls. were situated on the lateral wall of the pharynx under cover of the mandibular gland. The pterygoid lgl., present in most cases, was situated on the dorsolateral face of the pterygoideus muscle. Stokoe did not describe the hyoid lgls.

According to Thornton (1968), the parotid lnn., one on each side of the head, were located on the edge of the masseter muscle and covered by the parotid gland. They were flat nodes, 7.5 cm long by 2.5 cm wide. The submaxillary lnn. were situated just inside the angle of the mandible and embedded in fat. The retropharyngeal lnn. were divided into two groups: (a) internal retropharyngeal lnn., two to four in number, situated between the cornu of the hyoid bone; (b) lateral retropharyngeal lnn. situated beneath the wing of the atlas and, therefore, usually located on the neck end of the dressed carcase.

The parotid ln., according to Habel (1970), was situated on the cranial border of the parotid gland and the masseter, ventral to the temporomandibular joint. The mandibular ln. was situated on the ventral surface of the facial vein, ventral to the angle of the mandible, covered by the sternomandibularis muscle. The medial retropharyngeal lnn., embedded in fat, were situated between the caudal wall of the pharynx and the longus capitis muscle. The exact

location of the lateral retropharyngeal lnn. was not described, though, relation to the mandibular gland and the accessory nerve was presented.

Koch (1970) classified the lymph nodes of the head into: (a) nodes of clinical importance (palpable in patients) to which belonged the Ln. parotidicus and the Ln. mandibularis; (b) nodes important to meat inspection which included the Ln. retropharyngicus medialis and Ln. retropharyngicus lateralis. Both lymph nodes were oval to rounded in shape.

The lymph vessels of the head

According to Baum (1912), the Lgl. parotidea received afferent vessels from the skin of the head, except the nose tip and lips, the conchae and nasal septum (in part), the external nose, upper and lower lip, including the chin and dental pad, the gum of the lateral side of the third premolar, the temporomandibular joint and parotid gland, the mandible, incisive, nasal, frontal and malar bones, the external ear and muscles of the ear, the palpebrae, the caruncula lacrimalis, the muscles of the eye ball and the lacrimal gland. The efferent vessels, 8-12 in number, passed to the Lgl. retropharyngeal lateralis through different ways. The largest part of these vessels passed on the medial face of the stylohyoid bone, and then either on the lateral or medial face of the digastricus muscle. A

second part of the vessels passed on the lateral side of the occipitohyoideus muscle, and a third part passed on its medial side. A direct connection of the Lgl. parotidea and the Lgl. mandibularis was not observed by Baum, though occasionally vessels from the Lgl. parotidea joined those from the Lgl. mandibularis to terminate in the Lgl. retropharyngea lateralis. The Lgl. mandibularis received its afferent vessels from the skin of the head in small part, especially from the masseter, neck and nose regions, the greater part of the muscles of the head, the sterno-mandibularis muscle, the lower and upper lip, including the chin and dental pad, the gum of the maxillary teeth, the mental and lateral side of the incisors and the mandible, the premaxilla, and the nasal bones, the parotid and mandibular glands, the tip of the tongue, the hyoid muscles in part and the efferents of the Lgl. pterygoidea. The efferent vessels of the Lgl. mandibularis, 2-4 in number, passed to the Lgl. retropharyngea lateralis, on the lateral surface of the mandibular gland, one part to its cranial, another part to its caudoventral border. If two Lgl. mandibulares were present, they were then connected with each other by efferent vessels. Sometimes two efferents were present, originating from both lymph nodes. One of these vessels terminated in the Lgl. mandibularis, while the other passed directly to the Lgl.

retropharyngea lateralis or joined the efferent vessel of the Lgl. mandibularis. The afferent vessels of the Lgl. retropharyngea medialis came from the entire tongue, a part of the hyoid muscles and hyoid bone, the mucosa of the interalveolar space and the gum of the upper and lower molars and the lingual side of the lower incisors, the mucosa of the free part of the floor of the mouth, the hard and soft palate, including the region of the tonsils, larynx, esophagus, mandible, sublingual and mandibular glands, the caudal half of the nasal cavity, nasal septum and conchae, the mucosa of the maxillary and palatine sinuses, the longus capitis muscle and efferents of the Lgl. hyoidea oralis. The efferents of the Lgl. retropharyngea medialis, 4-8 in number, passed to the Lgl. retropharyngea lateralis. In cases where the latter consisted of several nodes, the efferents generally opened into the largest node. In exceptional cases, however, the efferent vessels opened into each node. The Lgl. retropharyngea lateralis received its afferents from the entire tongue, a part of the hyoid muscles, sublingual, parotid and mandibular glands, the cervical part of the thymus, the mucosa of the interalveolar space of the mandible, in some cases from the hard and soft palate, the upper and lower lips, the mucosa of the cheek and mandible, the external ear and ear muscles. Further, the Lgl.

retropharyngea lateralis received afferent vessels from the muscles of the neck, the masseter muscle, and efferents of the Lgl. parotidea, Lgl. mandibularis and Lgl. retropharyngea medialis. On the left side, 3-6 efferents came off the Lgl. retropharyngea lateralis, joined each other and formed a large efferent vessel, the left tracheal duct, which passed along the left face of the trachea and terminated in variable ways at the cranial thoracic aperture. In its course the duct received efferent vessels of the Lgl. cervicalis superficialis and the Lgl. cervicales profundae, including the Lgl. costocervicalis. Sometimes only a part of the efferents of the Lgl. cervicales was received by the tracheal duct. It was also observed that no efferent vessel of the Lgl. cervicales opened into the duct. In cases where the efferents of the Lgl. retropharyngea lateralis did not form the left tracheal duct, 1-2 vessels either opened into the Lgl. cervicales craniales or joined each other to form the left accessory tracheal duct. This duct passed parallel with the left tracheal duct, and at the middle of the neck, it usually joined the left tracheal duct. Efferents of the Lgl. cervicales craniales and mediae were received by the left accessory tracheal duct. Near the cranial thoracic aperture the left tracheal duct joined the terminal part of the thoracic duct or terminated into the left common jugular vein, or it divided into two branches: (a) one terminated

into the left external jugular vein; (b) the other opened into the thoracic duct or (in one case) into the right tracheal duct. On the right side of the head the relationship of the vessels resembled that of the left, however, the termination of the right tracheal duct was related differently. Generally, the duct opened into the right external jugular vein near the emerging site of the axillary vein. In some cases, however, the duct divided into two branches, which separately opened into the right common jugular vein. The right tracheal duct, shortly before it terminated, received efferent vessels of the Lgl. cervicalis superficialis dextra, Lgl. cervicales profundae dextrae, and the Lgl. costocervicalis dextra; further, efferents of the lymph nodes of the cranial thoracic aperture, and frequently also an efferent vessel of the Lgl. sternalis cranialis, therefore 0.5-2.0 cm long terminal part of the duct had a considerable width, and was called the right lymphatic trunk. Sometimes the efferent vessels of above mentioned lymph nodes, either wholly or for the greater part formed a special duct and the latter did not open into the thoracic duct, but into the common jugular vein.

Montané and Bourdelle (1917) stated that the afferent vessels of the ganglion parotidien arose from the parotid gland and the region of the ear and horn. The efferents passed to the ganglions pharyngiens. The ganglions maxillaires

received their afferent vessels from the surface of the head and the nasal cavity, the nose, lips and nasal region of the eye. Their efferents went to the jugular vein, but a certain number of them terminated in the ganglions pharyngiens. According to these authors, the ganglion pharyngiens received afferent vessels from the mouth, the caudal part of the nasal cavity, the pharynx and hyoid organs. Their efferents descended in the jugular groove.

Martin (1919) referred for a greater part to Baum's work (1912) in his description of the afferent and efferent vessels of the head.

Leighton (1927), referring to the lymphatic glands in the neighborhood of the parotid gland, stated that the afferent vessels of these lymphatic glands came from the ear, parotid gland, temporal region and base of the skull. Their efferents discharged their lymph into the upper cervical lymphatic glands. The submaxillary lgls. received their afferent vessels from the lower half of the head, therefore, including the cheek, nose, mucous membrane of the nose and gum. The efferent vessels carried the lymph to the upper lymphatic glands. The afferent vessels of the retropharyngeal lgls., according to Leighton, came from the cranial cavity, the base of the skull, larynx, and efferents of submaxillary lgls. and the lymphatic glands in the neighborhood of the parotid gland.

von Ostertag (1932, 1934) described the afferent and efferent vessels of the head of the ox, according to Baum (1912), except where otherwise indicated.

Egehøj (1934c) stated that his investigation for a greater part agreed with Baum's findings (1912). The difference he found should be considered that Baum's investigation may still be imperfect. Because the afferent vessels to the regional lymph nodes did not completely correspond to the exact relationship of their area of drainage. This presumption was verified by controlled investigations on the musculature. Because in some cases the lymph vessel connections between the masseter and the medial pterygoideus muscles and all lymph nodes could be demonstrated if injected in the living animal. In other cases it could not be shown by dissection that lymph vessel connections to all lymph nodes existed, although they received the injection dye. Whether these facts were caused by inaccurate investigation of the specimens or by other causes, Egehøj could not determine. Therefore, he suggested that the problem should be left open for further investigations. In many cases one must take into account that the deposition of the dye in the lymph nodes, after it was injected into the live animal, should be looked for the direct lymph vessel connections (even if they have not been pointed out by Baum, 1912), and that one had also to consider an

anastomosis between the lymph vessel system of the different tissue components as route for the distribution of the dye.

Sisson (1938), Somers (1951), Sisson and Grossman (1953) and Stokoe (1967) with regard to the afferent and efferent vessels of the parotid and mandibular lgls. basically agreed with Baum's description (1912). The afferent vessels of the suprapharyngeal lgls., according to these authors, came from the tongue, the floor of the mouth, the hard and soft palate, the gum in part, the pharynx, the sublingual and mandibular glands, the caudal part of the nasal cavity, the maxillary sinus, the larynx and the longus capitis muscle. The efferent vessels, 4-8 in number, united in forming the tracheal duct. The afferent vessels of the parapharyngeal lgl., according to Sisson and Grossman (1953) and Stokoe (1967) were similar to those of the atlantal lgl. The afferent vessels of the atlantal lgl., according to these authors, came from the tongue, the salivary glands, the gum in part, the cervical part of the thymus, most of the hyoid and cervical muscles, efferent vessels of the parotid, mandibular and suprapharyngeal lgls. The efferents, 3-6 in number, joined in forming the tracheal duct.

Edelmann et al. (1943) stated that the afferent vessels of the parotid lgl. came from the dorsal half of the head, the cranial cavity, the base of the cranium, the tongue, soft palate, esophagus and larynx. The efferents passed to

the superior cervical lgl. The submaxillary lgl. received their afferent vessels from the superficial parts of the head, interior nasal passages and buccal cavity. The efferent vessels coursed to the superior cervical lgl. The superior cervical or retropharyngeal lgl. received afferent vessels from the inside of the head, together with the cranial, buccal and tracheal cavities, and efferents of the parotid and submaxillary lgls.

Grau (1943) described the afferent and efferent vessels of the head of the ox for the greater part concordant with that of Baum's (1912) lymphatic system of the ox.

Dobberstein and Hoffmann (1964) stated that the afferent vessels of the Nn. ll. parotidei came from the caudal half of the head, and their efferents passed to the Nn. ll. retropharyngei laterales. The afferent vessels of the Nn. ll. mandibulares came from the cranial half of the head, the salivary glands and the tip of the tongue. The efferents passed to the Nn. ll. retropharyngei laterales. The afferent and efferent of the Nn. ll. retropharyngei, according to these authors, came from the skin of the musculature of the parotid region and the neck, tongue, mouth cavity, pharynx and larynx. Their efferents went to the tracheal duct.

According to Schwarze and Schröder (1964), the afferent vessels of the Lnn. parotidici came for a greater part from

the dorsal half of the head. Their efferents passed to the Lnn. retropharyngici. The Lnn. madibulares received afferent vessels from the ventral half of the head, the salivary glands and the tip of the tongue. They agreed that the efferent vessels went to the Lnn. retropharyngici. The Lnn. retropharyngici, according to these authors, received afferent vessels from the skin and muscles of the parotid and neck regions, tongue, mouth and nasal cavity, paranasal sinus, pharynx, larynx, thyroid gland and thymus. Their efferent vessels opened into the tracheal duct.

The parotid lnn., according to Thornton (1968), received afferent vessels from the muscles of the head, eye and ear, tongue, and the cranial cavity. Their efferents passed to the lateral retropharyngeal lnn. The afferent vessels of the submaxillary lnn. came from the head, nose and mouth. The efferent vessels went to the lateral retropharyngeal lnn. The retropharyngeal lnn. received afferent vessels from the tongue, efferents from the submaxillary, parotid and internal retropharyngeal lnn.

Koch (1970) stated that the afferent vessels of the Ln. parotidicus came from the caudal part of the skin, muscles and bones of the head, the mandibular joint, parotid gland, the external ear and the lacrimal apparatus. Its efferent vessels passed to the Ln. retropharyngicus lateralis. The afferent vessels of the Ln. mandibularis, according to Koch,

came from the skin of the cranial half of the head (including the regions of the cheek, orbital and zygomatic) all muscles of the head, mucosa of the mouth and nose, the salivary glands and the sternomandibularis muscle. Their efferents passed to the Ln. retropharyngicus lateralis. The Ln. retropharyngicus medialis received afferent vessels from the tongue, mucosa of the mouth cavity, larynx, pharynx, mandible, maxillary and palatine sinuses, and salivary glands (except the parotid gland). The efferent vessels passed to the Ln. retropharyngicus lateralis. The afferent vessels of the Ln. retropharyngicus lateralis resembled those of the Ln. retropharyngicus medialis, with additional afferents from the surrounding muscles, thymus and efferents of the earlier mentioned lymph nodes.

The Lymph Nodes and Lymph Vessels of the Head of the Sheep and Goat

The terminology of the lymph nodes of the head of the sheep and goat as applied by the various research workers has been presented in Table 1.

The lymph nodes of the head

Godbille (1915) stated that the lymph nodes of the head of the sheep were exactly the same as those described in the ox.

Montané and Bourdelle (1917) described that the ganglion

parotidien in the small ruminants was well developed. With regard to the ganglions sous-maxillaires and the ganglions pharyngiens, these authors did not describe specifically for each species.

According to Grau (1933), in the sheep the Lnn. parotidei consisted of 2-4 nodes. Occasionally a single lobed node, wrapped by a thin parenchyme layer, was observed instead. Generally, one node (or one large and 1-2 small) was situated directly under the cutaneus faciei muscle and the parotid fascia, respectively. Frequently on the caudal border of the masseter muscle and ventral to the temporomandibular joint, they were partly covered by the parotid gland. The nodes, in turn, covered the transverse facial vein, bordering the cranial aspect of the superficial temporal vein. The second nodes (or one large and one small), however inconstant, were located caudal to the first, and on the caudal (frequently also on the medial) face of the superficial temporal vein. They were completely covered by the parotid gland. The Lnn. mandibulares, consisting of 1-2 nodes and covered by the cutaneus faciei muscle, were situated on the ventral border of the mandible, midway between the incisura vasorum facialium and the angle of the mandible at the site of branching of the facial and submental veins. In case of a single node it was situated between the dorsal face of the facial vein and the caudoventral border of the masseter

muscle; related caudodorsally to the parotid gland, and caudally to the mandibular gland. When two nodes were found, the first one was dorsal and its relationship to the other structures of the head was similar as described above. The second node was situated ventral to the first on the submental vein, immediately at the latter's branching site from the facial vein. It was separated from the dorsal node by some fatty tissue, and by the submental vein from the rostral belly of the digastricus muscle. Further, it was related with its medial face to the caudal border of the mandibular gland. The Lnn. retropharyngei laterales, according to Grau (1933) were located on the caudal border of the parotid gland. They were partly covered by the caudal part of the latter and further by the aponeurosis of the brachiocephalicus muscle and, the largest of the nodes, by the occipital vein. The largest node was related caudally to the longus capitis muscle, craniodorsally to the tip of the jugular process of the occipital bone. Its medial face bordered the mandibular gland. Up to 6 nodes could be found lying caudoventral to the largest node and immediately on the dorsal aspect of the maxillary vein.

Iwanoff (1947-1948) stated that in the goat the Ln. parotidicus was situated at the base of the ear, caudal to the mandible, and covered by the parotidoauricularis muscle and the parotid gland. The length of the node varied from

2.3-2.5 cm. Dorsally the node was related to the auriculopalpebral nerve, ventrally to the ventral buccal branch of the facial nerve, and laterally to the dorsal buccal branch of the facial nerve. Caudally it was related to the external carotid and the superficial temporal arteries, medially to the nasal auricular and transverse facial arteries. The Ln. mandibularis was situated directly at the incisura vasorum facialium, or a little caudal and ventral of the mandible covered by the superficial fascia and the cutaneus faciei muscle. The node varied from 1.0-1.4 cm in length. Laterally the node was related to the facial artery and vein, and cranioventrally related to the sternomandibularis muscle. The Lnn. retropharyngici consisted of the Lnn. retropharyngici mediales and the Lnn. retropharyngici laterales. The Lnn. retropharyngici mediales, represented by a single node one on each side of the base of the skull, were located medial to the stylohyoid bone in a groove formed by the longus capitis muscle and the dorsal pharyngeal musculature; they measured 1.7-2.0 cm in length. A second node, 0.8 cm long, could be found caudal to the first and between the dorsal wall of the pharynx. The Lnn. retropharyngici laterales, 1.3-1.7 cm long, were located under the angle formed by the most dorsal part of the pterygoideus muscle and the obliquus capitis cranialis muscle on a level of the wing of the atlas. A second smaller node, 1.0 cm in

length, and two others could be found along the deep face of the mandibular gland. Medial to these lymph nodes coursed the vagus and sympathetic nerves and the common carotid artery. Cranially they were related to the hypoglossal nerve. The Ln. pterygoidea and the Lnn. hyoideae were not observed.

According to Sisson (1938) and Sisson and Grossman (1953), the lymph glands of the sheep, in general, resembled those of the ox, but a few special features were noted. The parotid lgl. was situated on the caudal border of the masseter muscle, about midway between the temporomandibular joint and the angle of the mandible. It was related to and generally partly covered by the parotid gland. It was flattened and had a deep notch caudally. The size was about 2.0 cm long. The mandibular lgls., usually two on each side of the head, were located caudal to the angle of the mandible on the course of the external maxillary vein. The larger one was flattened and kidney-shaped and about 2.5 cm in length. The suprapharyngeal lgls., two in number, had an elongated outline. They were located, 0.5 cm apart, on the dorsal wall of the pharynx. Laterally, they were related to the dorsal part of the stylohyoid bone and dorsally to the longus capitis muscle. They were about 2.0-3.0 cm long and half as wide. The atlantal lgl. was related to the ventral part of the paracondyle (jugular)

process and was situated dorsal to the common carotid artery. It was discoid or oval in outline, and about 1.5 cm long. Frequently there was a small node caudal to the atlantal lgl. and one or more hemal lymph nodes were present at this site.

According to May (1970), the Lnn. mandibulares were situated in the fat between the angles of the mandible (sheep). Generally, there were two nodes on each side, the caudal node lying caudal to the union of the submental and external maxillary veins, and the rostral one lying along the course of the submental vein. The larger caudal node was 2.0 cm long and 1.0 cm wide, oval in shape, with the hilus facing dorsolaterally. The Ln. parotideus was situated between the rostrodorsal border of the parotid gland and the masseter muscle. The dorsal buccal branch of the facial nerve and the transverse facial artery coursed across its medial face. The node was partly covered by the parotid gland and partly by fat, cutaneous muscle and fascia. It was 3.0 cm long and 1.75 cm wide, and oval in shape. The dorsal branch of the facial nerve occasionally passed through a canal formed in the ventral part of the node. Sometimes a second node was present lying caudal to the other and medial to the parotid gland near the conchal cartilage. The Lnn. retropharyngei mediales were located on the dorsal wall of the pharynx immediately caudal to the pterygopharyngeus and on the

surface of the thyropharyngeus muscle. One or two nodes may be found on each side, the larger first being 2.5 cm long and 1.3 cm wide, while the smaller node, lying caudal to the first was deeply located. Laterally the node was related to the termination of the common carotid artery and the glossopharyngeal nerve. The Lnn. retropharyngei laterales were located in the region of the atlantal fossa at the intersection of the caudal and dorsal borders of the mandibular gland. Surrounded by fat and covered superficially by the parotid gland the common carotid artery and the vagosympathetic trunk passed either deep or ventral to this group of lymph nodes. One to three nodes were present on each side with the largest measuring up to 2.5 cm long, lying cranially.

Though Habel (1970) included the sheep and the goat in his guide of dissection of the ruminants, no separate description with regard to the lymph nodes was given for these two species.

The lymph vessels of the head

According to Grau (1933), the afferent vessels from the skin of the head, including the parotid region and the mandibular space, passed to the Lnn. parotidea and the Lnn. mandibulares; a small part of these vessels went to the Lnn. retropharyngei laterales and the Ln. cervicalis superficialis. He reported that by intracutaneous injection of

the external nose, superficial and deep lymph vessels could be observed. The former, after passing on the levator nasolabialis and the buccal part of the buccinator muscle, coursed to the Lnn. mandibulares and the Lnn. parotidei. Occasionally, one of these vessels bypassed the Lnn. mandibulares, dipped under the parotid gland and terminated in the Lnn. retropharyngei. The deep vessels passed under the levator nasolabialis muscle and went to the Lnn. parotidei and Lnn. mandibulares. From the skin of the nose bridge the afferent vessels, which passed on the levator nasolabialis muscle, went to the Lnn. parotidei. The vessels of the lateral wall of the nose passed along the zygomatic crest and arch to the Lnn. parotidei, or after arriving on the rostral border of the masseter muscle followed the course of the dorsal branch of the facial nerve and terminated in the same node. From the upper lip afferent vessels went to the Lnn. mandibulares and Lnn. parotidei, while the vessels from the lower lip passed to the Lnn. mandibulares. The afferent vessels from the mandibular space went to the Lnn. parotidei, and a part of them passed to the Lnn. retropharyngei laterales. Most of the afferent vessels of the chin and middle part of the mandibular space, until the level of the incisura vasorum facialium ascended dorsally to the Lnn. parotidei. A part of these vessels bypassed the Lnn. parotidei and went to the Lnn. retropharyngei laterales.

Another part of these vessels penetrated the cutaneus faciei muscle and passed caudally under this muscle or along the ventral border of the mandible to the Lnn. mandibulares. Some vessels from the mandibular space could pass to the Ln. cervicalis superficialis. The afferent vessels from the caudal part of the mandible and the transition area between the mandibular and laryngeal regions exclusively passed to the Ln. cervicalis superficialis. The afferent vessels from the skin of the frontal region, after joining the vessels from the parietal region, opened into the Lnn. parotidei. The afferents of the parietal region went directly to the Lnn. parotidei. The occipital region and the area close to the crista sagittalis externa drained their lymph into the Ln. cervicalis superficialis. The afferent vessels of the upper eye lid accompanied the vessels from the frontal region and passed to the Lnn. parotidei. The afferents from the lower eye lid converged in the area of the temporomandibular joint and united with the afferents from the frontal region. The afferent vessels from the region of the masseter muscle exclusively passed to the Lnn. parotidei. However, from the skin, covering the rostral border of the masseter, the afferent vessels could be seen passing to the Lnn. mandibulares. The afferents of the dorsal part of the parotid region opened into the Lnn. parotidei and Lnn. retropharyngei laterales, while the

Lnn. mandibulares received afferents from the cranioventral part and the Ln. cervicalis superficialis from the greater part of this region. The afferent vessels from the cranial and medial side of the external ear passed to the Lnn. parotidei, while the afferents of the caudal and lateral side opened into the Lnn. retropharyngei laterales.

Iwanoff (1947-1948) stated that in the goat the Ln. parotidicus and Ln. mandibularis released efferent vessels to the Lnn. retropharyngici. The efferents of the latter constituted the tracheal duct.

According to May (1970), in the sheep the Ln. parotideus received its afferent vessels from the face, palpebral and facial regions, and from the parotid gland. The efferents ran caudally to the Lnn. retropharyngei laterales through the connective tissue of the parotid gland. The afferent vessels of the Lnn. mandibulares came from the cheek and facial regions, and followed the facial vein and its branches. Other afferent vessels came from the mandibular space and deeper structures of these regions along the branches of the external maxillary vein. The efferents passed to the Lnn. retropharyngei mediales. The Lnn. retropharyngei laterales received afferent vessels from the other lymph nodes of the head as well as from deeper structures of the head and cranial cervical region. The efferents of the Lnn. retropharyngei laterales united

to form the tracheal duct. The Lnn. retropharyngei mediales received afferent vessels from the tongue, soft palate, the floor of the mouth, pharynx, sublingual and mandibular glands, the caudal part of the nasal cavity, and the larynx. The efferent of the main node joined the Lnn. retropharyngei laterales.

According to May (1970), the tracheal duct of each side was formed by the efferent vessels of the lateral retropharyngeal lnn. It passed caudally at first along the dorsolateral surface of the trachea and then coursed medial to the common carotid artery in the caudal part of the neck. On the left side the duct joined the thoracic duct a short distance from the termination of the latter, while the right tracheal duct emptied either in the right lymphatic duct or the thoracic duct. There was generally a single duct on each side, but, occasionally, two to three ducts were present one being larger than the others.

The Lymph Nodes and Lymph Vessels of the Neck of the Ox

The terminology of the lymph nodes of the neck of the ox applied by various authors has been given in Table 2 and arranged in chronological order.

Table 2. Terminology applied to the lymph nodes of the neck and thoracic limb of the domestic ruminants

Group	Chauveau and Arloing, 1891 (ruminants)	Baum, 1912 (ox)
1	Prescapular glands	Lgl. cervicales superficiales
	--	Lgl. cervicalis superficialis
	--	Lgl. cervicales nuchales
	--	--
2	Prepectoral glands	Lgl. cervicales profundi
	--	Lgl. cervicales craniales
	--	Lgl. cervicales mediae
	--	Lgl. cervicales caudales
	--	Lgl. costocervicalis
3	Brachial glands	Lgl. axillaris propria
	--	Lgl. axillares primae costae
	--	--

	Martin, 1919 (ruminants)	Leighton, 1927 (ox)
1	--	--
	Lgl. cervicales superficiales	Prescapular lgl.
	--	--
	--	--
2	Lgl. cervicales profundae	--
	Lgl. cervicales craniales	Upper cervical lgl.
	Lgl. cervicales mediae	Lymphatic glands upon upper third of trachea
	Lgl. cervicales caudales	Lower cervical lgl.
	Lgl. costocervicalis	--
3	Lgl. axillaris proprius	Axillary lgl.
	Lgl. axillares primae costae	--
	--	--

	Godbille, 1915 (ox, sheep)	Montané and Bourdelle, 1917 (ruminants)
1	Prescapular or inferior cervical lgls.	Ganglions pre-scapulaires
	--	--
	--	--
	--	--
2	--	--
	Sub-atloid lgl.	--
	Middle cervical lgl.	Ganglions cerviceaux moyens
	--	--
	--	--
3	Subscapular or tracheal lgl.	Ganglion brachial Ganglions axillaires
	--	
	--	--

	von Ostertag, 1932 (ox)	Sisson, 1938; Sisson and Grossman, 1953 (ox, sheep)
1	--	--
	Ln. cervicalis superficialis	Prescapular or posterior superficial lgl.
	--	--
	--	--
2	Lnn. cervicales profundi	--
	Lnn. cervicales craniales	Anterior cervical lgl.
	Lnn. cervicales medii	Middle cervical lgl.
	Lnn. cervicales caudales	Posterior cervical lgl.
	Ln. costocervicalis	Costocervical lgl.
3	Ln. axillaris proprius	Axillary lgl.
	Lnn. axillares primae costae	--
	--	--

Table 2 (Continued)

Group	Grau, 1943 (ruminants)	Edelmann et al., 1943 (ox)
1	--	--
	Ln. cervicalis superficialis	Prescapular lgl.
	Lnn. (cervicales) nuchales	--
	--	--
2	Lnn. cervicales profundi	--
	Lnn. cervicales cranailes	--
	Lnn. cervicales medii	Middle cervical lgls.
	Lnn. cervicales caudales	Inferior cervical or prepectoral lgls.
	Ln. costocervicalis	--
3	Lnn. axillares proprii	Axillary lgls.
	Lnn. axillares primae costae	--
	--	--

	Somers, 1951 (ox, pigs, sheep)	von Ostertag and Schönberg, 1955 (ox)
1	--	--
	Prescapular lgls.	Ln. cervicalis superficialis
	--	--
	--	--
2	--	Lnn. cervicales profundi
	Anterior cervical lgls.	Lnn. cervicales craniales
	Middle cervical lgl.	Lnn. cervicales medii
	Prescapular or posterior cervical lgls.	Lnn. cervicales caudales
	--	Ln. costocervicalis
3	Axillary lgls.	Ln. axillaris proprius
	--	--
	--	--

	Webb, 1944 (domestic animals)	Iwanoff, 1947-1948 (goat)
1	--	--
	Superficial cervical ln.	Lnn. cervicales superficiales
	--	--
	--	--
2	Deep cervical lnn.	Lnn. cervicales profundi
	Cranial group	Ln. cervicalis profundus cranialis
	Middle group	Ln. cervicalis profundus medius
	Caudal group	Ln. cervicalis profundus caudalis
	--	Lnn. costocervicales
3	--	Lnn. axillares proprii
	--	Lnn. axillares primae costae
	--	--

	Dobberstein and Hoffmann, 1964 (ox)	Schwarze and Schröder, 1964 (ruminants)
1	--	--
	Nn. ll. cervicales superficiales	Lnn. cervicales superficiales
	--	Lnn. (cervicales) nuchales
	--	--
2	--	Lnn. cervicales profundi or tracheales
	Nn. ll. cervicales craniales	Lnn. cervicales profundi craniales
	Nn. ll. cervicales medii	Lnn. cervicales profundi medii
	Nn. ll. cervicales caudales	Lnn. cervicales profundi caudales
	--	Lnn. costocervicales
3	N. l. axillaris proprius	Lnn. axillares proprii
	Nn. ll. axillares primae costae	Lnn. axillares primae costae
	--	Ln. axillaris accessorius

Table 2 (Continued)

Group	Thornton, 1968 (ox)	Nomina Anatomica Veterinaria, 1968 (ruminants)
1	--	--
	Prescapular ln.	Lnn. cervicales superficiales
	--	Lnn. cervicales superficiales accessorii
	--	--
2	--	--
	Upper cervical lnn.	Lnn. cervicales profundi craniales
	Middle cervical lnn.	Lnn. cervicales profundi medii
	Lower cervical lnn.	Lnn. cervicales profundi caudales
	Costocervical lnn.	Ln. costocervicalis
3	Axillary or brachial ln.	Lnn. axillares proprii
	--	Lnn. axillares primae costae
	--	Lnn. axillares accessorii

	Koch, 1970 (ox, sheep)	May, 1970 (sheep)
1	--	--
	Ln. cervicalis superficialis	Lnn. cervicales superficiales caudales
	--	--
	--	Ln. cervicalis medius superficialis
2	--	--
	Lnn. cervicales profundi craniales	--
	Lnn. cervicales profundi medii	Lnn. cervicales medii
	Lnn. cervicales profundi caudales	Lnn. cervicales caudales
	Ln. costocervicalis	Ln. costocervicalis
3	Ln. axillaris proprius	Ln. axillaris
	Lnn. axillares primae costae	--
	--	--

The lymph nodes of the neck

According to Baum (1912), the lymph nodes of the neck could be divided into superficial and deep groups. The superficial group consisted of the Lgl. cervicales superficiales, which included the Lgl. cervicalis superficialis and the Lgl. cervicales nuchales. The Lgl. cervicalis superficialis, measuring in the adult animal 7.0-9.0 cm in length, 1.5-2.0 cm in width, and 1.0-1.5 cm in thickness, was situated on the cranial border of the supraspinatus muscle, craniodorsal to the shoulder joint. Its ventral third was covered by the brachiocephalicus muscle and its dorsal two-third was covered by the omotransversarius muscle, and at the same time it was located on the scalenus medius muscle. The Lgl. cervicales nuchales, 5-10 nodes in number, measuring from pin head size to 2.5 cm, were located under the trapezius muscle being embedded in fat, along the cranial border of the supraspinatus muscle. No hemal lymph node occurred in the vicinity of these lymph nodes; however, the Lgl. cervicales nuchales, because of their dark color could not be ascertained whether they were lymph nodes or hemal lymph nodes. The deep group, according to Baum (1912), consisted of the Lgl. cervicales profundae, which were situated on both sides of the lateral wall of the trachea and could vary in number and location. He divided them into cranial, middle, caudal and costocervical

nodes, depending on the part of the neck in which they were located, however, this division was not always distinct. The Lgl. cervicales craniales, 4-6 nodes, measuring 1.0-2.5 cm long, were situated partly at the beginning of the trachea, and partly near the thyroid gland. Their location on the cranial part of the neck varied widely. In some cases they could even be absent. In their vicinity small hemal lymph nodes were observed. The Lgl. cervicales mediae, consisting of 1-7 nodes, measuring 0.5-3.0 cm long, were frequently situated close to each other on the middle third of the cervical part of the trachea. On the right side of the neck the nodes rested directly on the trachea, slightly ventral to the right common carotid artery, while on the left side, mostly also on the trachea, but at the same time on the ventral face of the esophagus. Small hemal lymph nodes were observed in the vicinity of the Lgl. cervicales mediae. The Lgl. cervicales caudales, 2-4 in number, represented a group of nodes, lying on the trachea cranial to the first rib. Frequently the Lgl. axillares primae costae were included with the Lgl. cervicales caudales. One of the caudal cervical nodes was the Lgl. cercicalis caudalis manubrii sterni, lying close to and over the manubrium sterni cranial to the first rib, immediately at the origin of the sternohyoideus, sternothyroideus and sternocephalicus muscles. On the left and right side of the neck a second

smaller node, however inconstant, could be found cranial to the Lgl. cervicalis caudalis manubrii sterni. One to three nodes, measuring 1.0-3.0 cm long, could be seen lying 1.0-5.0 cm cranial to the first rib on the external jugular vein (dorsal to the subclavius muscle, a part of them on its lateral or medial face), or on the lateral face of the scalenus medius muscle or on the trachea ventral to the preceding muscle. They could also be deeply located between the scalenus medius muscle and the trachea in a slightly dorsal direction. In some cases 1-2 small nodes, embedded in fat, could be found extending for some distance from the first rib, on the lateral side of the external jugular vein, however, Baum doubted whether they should be included to the Lgl. cervicales mediae or the Lgl. cervicales caudales. Baum observed 2-14 hemal lymph nodes of variable sizes (pin head to 1.5 cm long) in the fat tissue surrounding the Lgl. cervicales caudales. The Lgl. costocervicalis, surrounded by fat, was located on the cranioventral side of the costocervical trunk somewhat cranial to the first rib. It was 1.5-3.0 cm long and wide, and 0.75-1.25 cm thick. It was related laterally to the scalenus medius muscle and the first rib, dorsally to the costocervical trunk and the longus colli muscle, ventrally to the common carotid artery and the vagosympathetic trunk. Medially it was related to the trachea and esophagus. Hemal

lymph nodes could be observed in the vicinity of this node. Baum (1912) stated that the Lgl. costocervicalis formed the transition of the Lgl. cervicales caudales to the Lgl. mediastinales craniales and the lymph nodes of the cranial thoracic aperture.

Godbille (1915) stated that, when removing the fore limb of the ox from the thorax, and the incision into the superficial muscles of the neck had been made, close to the cranial border of the shoulder, the prescapular lgl. and the chain of hemal lymph nodes were found adherent to the base of the neck, surrounded by fat. On the surface of the subcutaneous portion of the omotransversarius muscle, occasionally 2-5 hemal lymph nodes were found on the medial surface of the external jugular vein and along the common carotid artery; if this had been left by the technician when he removed the trachea, one might find small scattered lymphatic glands which were so minute as to be almost indistinct. These were the middle cervical lgls., situated on a level with the bifurcation of the jugular vein, namely at the larynx. One of these glands was usually larger than the rest. The sub-atloid lgl. was situated on the dorsal part of the neck under the wing of the atlas and on the course of the occipital artery and vein. As large as an almond the node was located against the small rectus capitis lateralis muscle and the mandibular gland.

According to Montané and Bourdelle (1917), the ganglions pre-scapulaires were reduced to an elongated, large single node situated cranial to the shoulder. A chain of hemal lymph nodes were observed along the cranial border of the shoulder. The ganglions cerviceaux moyens formed a double chain on the caudal aspect of the trachea which appeared to extend to the ganglions pharyngiens. They were easily seen between some hemal lymph nodes. Leighton (1927) designated the group of lymphatic glands of the neck: the upper, middle and lower cervical glands. The upper cervicals were situated on either side of the caudal wall of the pharynx in the region of the thyroid gland. He included in this group the retropharyngeal lgls. which were found on the caudal wall of the pharynx. The middle cervical lgls. were found on the upper third of the trachea. The lower cervical lgls. lay immediately cranial to the cranial thoracic aperture and on the ventral wall of the trachea. The prescapular lgl. was located cranial to the shoulder joint, where it was covered only by the thin portion of the brachiocephalicus muscle. In the ox, according to Leighton, the prescapular lgl. was single.

Sisson (1938) and Sisson and Grossman (1953) stated five groups of lymph nodes in the neck. These were the anterior, middle and posterior cervical lgls., the costo-cervical lgl. and the prescapular lgl. The presence of the

nuchal cervical lgls. was referred to Baum (1912). The anterior cervical lgls., according to these authors, were situated on the cranial part of the trachea along the course of the common carotid artery. Four or five nodes were present, measuring 1.0-2.5 cm in length. The middle cervical lgls. were located on each side of the trachea, near the middle third of the neck. Their position, number and size varied; they might extend to the cranial group or reach caudally to the caudal group. One to seven nodes could be found on either side of the neck, measuring 0.5-3.0 cm in length. Hemal lymph nodes were observed near them. The posterior cervical lgls., 4-5 in number and measuring 1.0-1.5 cm long, were situated near the cranial thoracic aperture. One of them was situated dorsal to the manubrium sterni and the ventral cervical muscles attached to it. The position of the other three or four lymph nodes might vary. The costocervical lgl., measuring 1.5-3.0 cm in length, was located lateral to the trachea (right side) and esophagus (left side) and dorsal to the common carotid artery and the vagosympathetic trunk; usually cranial to the first rib it was covered by the scalenus medius muscle, but might lie partly medial to the first rib. The prescapular lgl., elongated in shape and measuring 7.0-10.0 cm long and about 3.0 cm wide, was situated along the cranial border of the supraspinatus muscle, 10.0-12.0 cm above the shoulder joint,

and covered by the omotransversarius and brachiocephalicus muscles.

According to Grau (1943), the Ln. cervicalis superficialis, embedded in fat and 7.0-9.0 cm long, was situated close to cranial and dorsal aspects the shoulder joint, medial to the brachiocephalicus and omotrasversarius muscles. The Lnn. (cervicales) nuchales were described concordant to Baum (1912). The Lnn. cervicales profundi were located at variable places on the lateral face of the trachea. He divided them into the Lnn. cervicales craniales, Lnn. cervicales medii and Lnn. cervicales caudales. The latter were located immediately cranial to the first rib. According to Grau (1943), the Ln. costocervicalis was included in the Lnn. cervicales caudales. The Ln. costocervicalis measured 1.5-3.0 cm in length and was situated on the cranioventral face of the costocervical trunk, medial to the cranial border of the first rib.

Edelmann et al. (1943) stated that the prescapular lgl. was located on the cranial border of the shoulder, above the scapulohumeral articulation, and covered principally by the angularis scapulae (serratus ventralis cervicis) muscle and sometimes by the dorsal border of the mastoidohumeralis (brachiocephalicus) muscle. These authors considered the retropharyngeal lgl. as superior cervical lgl., and their location had been described in the discussion of

the lymph nodes of the head of the ox. The middle cervical lgls. were situated at the middle of the neck on the side of the trachea cranial to the common carotid artery. The inferior or prepectoral lgls. were located at the entrance of the thorax, ventral to the trachea, extending into the thoracic cavity.

Somers (1951) stated that the prescapular or posterior cervical lgls., embedded in a cushion of fat, elongated in shape and measuring 10.0-12.0 cm in length and 2.5 cm or more in width, were located a little above and medial to the shoulder joint. The anterior and middle cervical lgls. varied in number and location. In the ox, generally, they were found on each side of the cranial and middle third of the trachea along the course of the common carotid artery. The prepectoral or posterior cervical lgls. were located at the entrance of the cranial thoracic aperture, between the ventral and cranial borders of the two ribs, lateral of and ventral to the trachea and esophagus.

According to Dobberstein and Hoffmann (1964), the Nn. ll. cervicales superficiales, which they included in the superficially located lymph nodes, were situated closely above the shoulder joint, on the cranial border of the pectoralis cleidoscapularis (pectoralis profundus) muscle. The cervical lymph nodes, classified as deep lymph nodes by these authors, consisted of the Nn. ll. cervicales craniales,

cervicales medii, and cervicales caudales. The first group of these nodes was situated on a level of the thyroid gland, dorsal to the trachea. The second group was located at the middle of the neck, lateral to the trachea and ventral to the common carotid artery. The third group, if present, was located close to the first rib ventral to the trachea. No description was given on the costocervical ln.

Schwarze and Schröder (1964) reported that the Lnn. cervicales superficiales of the ox consisted of one node. It was 9.0 cm long and located cranial and dorsal to the shoulder joint, and medial to the brachiocephalicus and omotransversarius muscles. The Lnn. (cervicales) nuchales were situated medial to the trapezius muscle and on the cranial border of the supraspinatus muscle. The Lnn. cervicales profundi s. tracheales were divided into three groups, in many cases with indistinct limits. The Lnn. cervicales profundi craniales were located at the beginning of the trachea and frequently on the thyroid gland. The Lnn. cervicales profundi medii were located at the middle part of the trachea and the Lnn. cervicales profundi caudales on the terminal cervical part of the trachea, immediately cranial to the first rib. The Ln. costocervicalis was situated medial to the scalenus medius muscle, close and cranial to the first rib.

According to Stokoe (1967), the anterior cervical lgls.,

4-5 in number, were situated on the cranial part of the trachea along the course of the common carotid artery. The middle cervical lgls. were located on each side of the trachea in the middle third of the neck. The posterior cervical lgls. were situated near the cranial thoracic aperture. The costocervical lgl. was situated in front of the first rib lateral to the trachea (right side) and esophagus (left side) and dorsal to the common carotid artery.

Thornton (1968) stated that the prescapular ln. was elongated, 7.5-10.0 cm long and 2.5 cm or more in width. It was situated about 10.0 cm cranial to the shoulder joint, embedded in fat. The upper or cranial cervical lnn. were not described by this author. The middle cervical lnn. were situated in the middle of the neck on each side of the trachea and often absent in the ox. They varied in number from 1-7 nodes, and also in position and size. The prepectoral or lower cervical lnn., according to Thornton, were considered anatomically as a continuation of the upper and middle cervical chain. The middle cervical group might, in fact, extend to the upper group, or might reach caudally almost to the prepectorals. The prepectoral lnn., 2-4 in number, were embedded in fat along the cranial border of the first rib. Hemal lymph nodes were present in the fat around this group. The costocervical ln. was located on the medial

side or just cranial to the first rib and close to its articulation with the first thoracic vertebra. It was located adjacent to the esophagus and trachea and frequently removed with these in dressing the carcase, being found cranial to the heart and lungs.

Koch (1970) stated that the Ln. cervicalis superficialis was an elongated cigar-shaped node, measuring 9.0 cm long. It was located on the cranial border of the pectoralis cleidoscapularis (pectoralis profundus), covered by the brachiocephalicus and omotransversarius muscles. The Lnn. cervicales profundi, according to Koch, did not show a distinct grouping, but a chain of paratracheal lymph nodes instead, extending from the larynx to the cranial thoracic aperture. The Lnn. cervicales caudales, the only important lymph nodes, were situated close to the cranial thoracic aperture on the trachea and cranial to the first rib. The Ln. costocervicalis was situated medial to the first rib, laterally related to the esophagus and the superficial cervical artery.

According to Habel (1970), the superficial cervical ln., 7.0-9.0 cm long in the adult animal, was situated under the omotransversarius and brachiocephalicus muscles, on the cranial border of the supraspinatus muscle. Deeply the node was related to the superficial cervical artery. The cranial deep cervical lnn., according to this author, were

situated lateral to the common carotid artery and craniodorsal to the thyroid gland. The middle deep cervical lnn. were not described. The caudal deep cervical lnn. clustered around and in the cranial thoracic aperture. A node was usually present on the ventral surface of the trachea slightly cranial to the cranial thoracic aperture. Other nodes were related to the axillary vessels on the cranial and lateral surface of the first rib. The costocervical ln. was located at the cranial border of the first rib, lateral to the esophagus on the left and the trachea on the right side of the body. On the right it was covered by the cupula pleurae.

Dyce and Wensing (1971) stated that the superficial cervical ln. was a single large node, situated in the caudal part of the neck cranial to the scapula. The node rested upon the deep muscles over the cervical vertebrae and was covered by the omotransversarius muscle. A series of deep cervical lnn. was spread along the tracheal trunk. These were divided into cranial, middle and caudal clusters.

The lymph vessels of the neck

According to Baum (1912), the Lgl. cervicalis superficialis received afferent vessels from the skin of the neck and fore limb, the cranial part of the thorax, the cranial two-third of the ventral thoracic wall, the dorsum and lateral thoracic wall starting from the olecranon line to

the dorsal end of the 10th-12th rib; further afferents from the trapezius, latissimus dorsi, serratus ventralis, brachiocephalicus, rhomboideus cervicalis, omotransversarius, supraspinatus, infraspinatus and deltoideus muscles; from the tendon of muscles of the forearm and foot; the antebrachial fascia and carpal ligament; from the capral, metacarpal and digital joints; and efferents from the Lgl. cervicales nuchales. Generally, only one efferent vessel came from the Lgl. cervicalis superficialis. On the left side the vessel emptied in the terminal part of the thoracic duct or in the left tracheal trunk; on the right side it opened into the right tracheal trunk. Variation of number and termination of the efferent vessel of this node could be observed in some specimens. Since the Lgl. cervicales nuchales for a great part consisted of hemal lymph nodes Baum (1912) reported that the afferent and efferent vessels of these nodes were only observed in some cases. The Lgl. cervicales profundae received their afferent vessels from the sternocephalicus, brachiocephalicus, omohyoideus, sternohyoideus, longus colli, longus capitis and scaleni muscles; further from the thyroid, larynx and the pharyngeal muscle (cricopharyngeus); from the cervical part of the esophagus and trachea; and partly also from the thoracic part of the esophagus, the cervical part of the thymus; and efferent of the Lgl. retropharyngea lateralis, Lgl.

axillaris propria and Lgl. axillares primae costae. According to Baum, one efferent vessel came off the Lgl. cervicales profundae which opened into the right or left tracheal duct, depending on their location in the body. If a left or right accessory tracheal duct was present, the efferents opened into the accessory trunk. Many variations of termination were observed, especially of the Lgl. cervicales profundae. Their efferent terminated either in the end of the thoracic duct or in the last part of the left tracheal duct. On the right side the efferent of the Lgl. cervicales caudales opened in the last part of the tracheal trunk, however, the vessel occasionally joined the efferents of the Lgl. axillares primae costae or the efferent of the Lgl. cervicalis superficialis. An efferent vessel of the Lgl. cervicalis caudalis manubrii sterni opened into the left tracheal duct, close to its junction with the thoracic duct. The Lgl. costocervicalis received afferent vessels from the supraspinatus, infraspinatus, trapezius, rhomboideus, serratus ventralis, splenius, longissimus capitis and atlantis, semispinalis capitis, spinalis cervicis and thoracis, omohyoideus, longus capitis and scalenus (scaleni) muscles; from the costal pleura and trachea, efferents from the Lgl. intercostales of the 2nd-4th intercostal space, and efferents from the Lgl. mediastinales craniales and Lgl. rhomboidea. The left efferents of the Lgl. costocervicalis,

2-3 in number, opened in a variable manner into the thoracic duct. On the right side its efferents could open into the tracheal duct or the efferent of the Lgl. cervicalis superficialis.

Leighton (1927) stated that the afferent of the prescapular lgl. came from the superficial nodes of the neck, arm and forearm, therefore, they formed an important guide in estimating the condition of the forequarters of the body. The efferent vessel of this node was not described by this author.

Egehøj's investigation (1934b) showed that the Lgl. cervicales profundae received all the dye injected into the subcutis. Obviously, this result was contrary to the relationship of the lymph vessels of the skin stated by Baum (1912). The deviation obtained at this point, however, was insignificant as it appeared at first sight. Because a part of the dye which was deposited in the Lgl. cervicales profundae apparently has passed through other lymph nodes, before it arrived at the Lgl. cervicales profundae. In this relationship the Lgl. cervicalis superficialis should be taken into account. The lymph from this node was brought to the Lgl. cervicales profundae. Thus, one could say beyond doubt that the deposition of the dye in the Lgl. cervicales profundae was as a result of its forward movement, to and from

the Lgl. cervicalis superficialis. Thus no other deviations were found between the distribution of the lymph vessels of the skin and the subcutis of the neck, other than those, which were concerned with the distribution to the Lgl. retropharyngea lateralis and medialis. The relationship, however, was not surprising. If one considered the sites of injection of the above mentioned lymph nodes, such distribution seemed very obvious.

von Ostertag (1932, 1934), Sisson (1938), Grau (1943) and Sisson and Grossman (1953) basically described the afferent and efferent lymph vessels in accordance with Baum's monograph (1912)

Webb (1944) stated that the deep cervical lnn. of the ox were not large and constant, and the tracheal duct did not pass through them as it did in the horse. The efferent vessels of these lymph nodes passed to the tracheal duct. The superficial cervical ln. was particularly large, the efferent of which passed directly to the tracheal trunk.

Somers (1951) described the afferent and efferent vessels of the prescapular, the anterior and middle cervical, and prepectoral lnn. in agreement with Sisson and Grossman (1953).

Dobberstein and Hoffmann (1964) stated that the afferent vessels of the Nn. ll. cervicales superficiales of the ox came from the skin of the caudal part of the head and neck,

neck muscles, the skin of the shoulder and thoracic limb, the thorax and lateral wall of the thorax, the thoracic and cutaneous muscles, the muscles of the shoulder, arm, tendon of the forearm, axis vertebra, all bones of the thoracic limb, except the ulna, all joints, including the temporomandibular, however, not the elbow joint, and the hoof and dewclaws. The efferent vessels of the left side opened into the thoracic duct, while that of the right side opened into the right tracheal duct. The Nn. ll. cervicales craniales and medii, according to these authors, received afferent vessels from the muscles of the neck, cervical vertebrae, trachea, esophagus, thyroid gland and thymus. The efferents of the Nn. ll. cervicales craniales opened into the tracheal trunk, while those of the Nn. ll. cervicales medii terminated in the Nn. ll. cervicales caudales, but in the absence of the latter, the efferents passed directly to the tracheal duct. The afferent vessels of the Nn. ll. cervicales caudales came from the muscles of the neck, shoulder and arm, the pectoral muscles, serratus ventralis muscle, the scapula, humerus, shoulder joint, trachea, esophagus and thymus. The efferents passed either to the tracheal trunk or the thoracic duct or directly to the external jugular vein.

According to Schwarze and Schröder (1964), the afferent and efferent vessels of the Lnn. cervicales superficiales essentially agreed with the description of Dobberstein and

Hoffmann (1964). The afferent vessels of the Lnn. cervicales profundi came from the neck (excluding the skin), the muscles of the shoulder and arm, and the pectoral muscles. Their efferents passed to the Lnn. cervicales profundi caudales, which in turn released efferent vessels opening either into the tracheal trunk, the thoracic duct or the external jugular vein.

Stokoe (1967) stated that the prescapular lgl. received afferent vessels from the skin of the neck, part of ventral and lateral surface of the thorax, thoracic limb and muscles of the shoulder girdle. The efferents passed to the right tracheal trunk on the right side, and to the terminal part of the thoracic duct or the left tracheal duct on the left side. The anterior, middle and posterior cervical lgls. received afferent vessels from the ventral muscles of the neck, esophagus, larynx, trachea, thyroid and cervical part of the thymus. The efferents passed mainly to the tracheal duct, but from the posterior group they might go to the terminal part of the thoracic duct or the bijugular trunk. The costocervical lgl. received afferent vessels from the muscles of the neck and shoulder, costal pleura, trachea, and efferents of the intercostal and anterior mediastinal lgls.

According to Thornton (1968), the afferent vessels of the prescapular ln. came from the head, neck, shoulder and

fore limb. The efferents passed to the thoracic duct. The middle cervical lnn. received afferent vessels from the lateral retropharyngeal lnn., while their efferents passed to the prepectoral lnn. The lower or prepectoral lnn. received afferent vessels from the upper and middle cervical lnn., together with the efferents of the prescapular ln.; thus all lymph vessels of the head and neck passed through the prepectoral lnn. The efferents of the prepectoral lnn. opened into the thoracic duct.

Koch (1970) stated that the afferent vessels of the Ln. cervicalis superficialis came from the skin of the neck and thoracic limb, a part of the skin of the head, the lateral wall of the thorax, the thorax proper, muscles of the thorax and superficial muscles of the neck, muscles of the shoulder and arm, the metacarpus with the skin and tendons, all bones of the thoracic limb (except the ulna) the axis vertebra, all joints and the hoof. The efferents passed to the tracheal duct or on the left side to the thoracic duct. The Lnn. cervicales profundi received afferent vessels from the muscles of the neck, larynx (including all related muscles of the larynx), thyroid gland, trachea and esophagus, thymus and thoracic and axillary lymph nodes. According to Koch, no afferent from the skin opened into the Lnn. cervicales profundi. The efferents of the Lnn. cervicales profundi terminated into the tracheal duct or the thoracic duct.

The Ln. costocervicalis received afferent vessels from the surrounding muscles, the costal pleura up to the 6th rib, the trachea and the neighboring lymph nodes of the thorax. The efferents went to the tracheal or the thoracic duct.

The Lymph Nodes and Lymph Vessels of the Neck of the Sheep and Goat

The terminology of the lymph nodes of the neck of the sheep and goat as given by various authors has been presented in Table 2.

The lymph nodes of the neck

According to Grau (1933), in the sheep the Ln. cervicalis superficialis was situated on the cranial border of the supraspinatus muscle, embedded in fat, covered by the omotransversarius muscle and the cervical part of the trapezius. Medially it was related to the serratus ventralis muscle. Sometimes dorsal or craniodorsal to this node a smaller one might be found. The Ln. nuchalis, according to Grau, was situated in the space between the second and third cervical vertebrae, slightly dorsal to or on a level of transverse process, in a small accumulation of fat, in the muscular interval between the ventral border of the splenius and the serratus ventralis cervicis muscles. The Lnn. cervicales craniales, medii and caudales were found

on the cervical part of the trachea in the neighborhood of the common carotid artery. The Lnn. cervicales caudales formed a group of nodes, which on either side, more or less were situated on the trachea closely cranial to the first rib. The Ln. costocervicalis was situated in the fat tissue of the cranial thoracic aperture along the cranial border of the costocervical trunk, medial to the scalenus medius muscle and the first rib, further directly dorsal to the external jugular vein and the lateral face of the common carotid artery.

Iwanoff (1947-1948) stated that in the goat the Lnn. cervicales superficiales consisted of two nodes, measuring 2.5-3.6 cm and 1.5-2.0 cm in length, respectively, which were partially fused. They were located cranial to the supraspinatus muscle, laterally covered by the omotransversarius muscle, medially they were related to the serratus ventralis cervicis muscle. The Lnn. cervicales profundae comprised: (a) Ln. cervicalis cranialis, 0.6-0.8 cm in diameter, was located ventral to the first and second tracheal rings, close to the midline. (b) Ln. cervicalis medius, an inconstant node, which occurred only on one side (either left or right), was located on the middle of the neck on the top of the tracheal ring. (c) Lnn. cervicales caudales, two nodes with an average measurement of 2.0 cm in length, were located at the bifurcation of the bicarotid

trunk, about 4.0 cm cranial to the manubrium sterni. The two nodes were placed side by side close to each other, so that the left one was situated somewhat ventral to the esophagus, while the right node rested ventral to the trachea. In other cases the nodes could rest on the corresponding common carotid artery or fused together as a single node. The Lnn. costocervicales, 1-2 nodes, measuring 0.5 cm in diameter if round, or 0.5-1.0 cm in length if oblong, were located medial or craniomedial to the first rib, on the lateral face of the trachea, at the angle formed by the subclavian artery and the costocervical trunk. On the left side they were located caudal to the costocervical trunk and vein. Sometimes medial to the vein, one rather small node, 0.1-0.2 cm in diameter, was located more cranially, partly beyond the first rib. It was covered laterally by the scalenus medius muscle and might be confused with the Lnn. cervicales profundi. Iwanoff (1947-1948) did not observe the Lnn. nuchales.

According to May (1970), in the sheep the Lnn. cervicales superficialis caudales were located beneath the omotransversarius and trapezius muscles, directly cranial to the supraspinatus muscle. The group was made up of a large and a small node, the small one being located near the hilus of the large node with hemal lymph nodes in many cases. The large node was 5.0 cm long, 2.0 cm wide, and 1.0 cm thick.

May did not describe the Lnn. cervicales craniales. Occasionally the Lnn. cervicales medii were found scattered in the midventral region of the trachea. The Lnn. cervicales caudales, two in number, were located on the ventral face of the esophagus between the two jugular veins and were crossed laterally by the artery to the scaleni and sternocephalicus muscles. These nodes were approximately 2.5 cm long, and were located about 5.0 cm cranial to the cranial thoracic aperture. Another small node of this group was situated cranial to the superficial pectoral muscles. The Ln. costocervicalis was located ventral to the trachea on the right side and to the esophagus on the left, dorsal to the common carotid artery and the vagosympathetic trunk. It was covered laterally by the scalenus medius muscle and the first rib. May stated that medial to the cleidocervicalis muscle and at the cranial border of the origin of the serratus ventralis cervicis muscle a lymph node, sometimes two, might be found which he called the Ln. cervicalis medius superficialis. The node was circular in shape and 2.0 cm in diameter.

The lymph vessels of the neck

Grau (1933) reported that in the sheep the afferent vessels from the skin of the neck passed to the Ln. cervicalis superficialis, and in some cases to the Lnn. retropharyngei

laterales and the Lnn. mandibulares. The majority of the vessels coursed in the fascia of the neck, and a small part under the fascia; they converged to form pairs and cranial to the shoulder, they passed partly dorsal to and partly along the ventral border of the omotransversarius muscle before entering the Ln. cervicalis superficialis. The afferents which went to the Lnn. retropharyngei laterales and Lnn. mandibulares came from the cranial third of the neck. The Ln. cervicalis superficialis also received lymph from the thoracic limb.

According to Grau (1934), three regions of the trunk could be designated: (a) the region of the neck up to the cranial border of the scapula; the afferent vessels from this region coursed to the Ln. cervicalis superficialis, Lnn. retropharyngei laterales, Ln. costocervicalis, Ln. nuchalis, and a small part to Lnn. cervicales caudales; (b) region under the scapula; the afferents from this region went to the Lnn. axillares and Lnn. axillares primae costae, a part to the Ln. cervicalis superficialis, a small part (from the serratus ventralis muscle), however, also to the Ln. costocervicalis. They also could penetrate the thoracic wall and passed to the Lnn. intercostales, Lnn. mediastinales dorsales (aortici) or Lnn. sternales; (c) the region caudal to the scapula on the thoracic wall; the afferent vessels of this region coursed to the Lnn. axillares and Lnn. axillares

primae costae or to the Lnn. intercostales, Lnn. mediastinales dorsales (aortici) and the Lnn. sternales. From the muscles caudal to the linea anconea afferent vessels passed to the lymph nodes in the thoracic cavity. Again, in this region a horizontal plane divided the trunk into two halves between the dorsal and ventral thoracic lymph nodes. The Ln. axillaris accessorius, when present lay caudal to the shoulder, received afferents from the deep pectoral muscles. The afferent vessels from the thoracic limb and remaining part of the trunk in the arm region passed to the two axillary lymph nodes and Ln. cervicalis superficialis.

According to Iwanoff (1947-1948), in the goat the efferent vessels of the Lnn. cervicales superficiales, Lnn. cervicales profundi, Ln. costocervicalis opened directly into the tracheal trunk or the thoracic duct.

May (1970) stated that in the sheep the afferent vessels of the Lnn. cervicales medii converged from the trachea and the region immediately ventral to the trachea, while the efferents joined the tracheal trunk, in some cases might join the Lnn. cervicales caudales. The afferent vessels of the Ln. cervicalis medius superficialis came from deeper structures, dorsal to the vertebral column in this region, and its efferents passed caudally on the serratus ventralis muscle to the Lnn. cervicales caudales.

The Lymph Nodes and Lymph Vessels of the Thoracic Limb of the Ox

The terminology applied to the lymph nodes of the thoracic limb of the ox used by various authors has been given in Table 2.

The lymph nodes of the thoracic limb

According to Baum (1912), two groups of lymph nodes were found in the thoracic limb. These were the Lgl. axillaris propria and the Lgl. axillares primae costae. The Lgl. axillaris propria, measuring 2.5-3.5 cm long, 1.25-2.0 cm wide, and 0.75-1.0 cm thick in the adult, was situated 6.0-10.0 cm caudal to the shoulder joint on the medial side of the teres major muscle. Its relation to the vessels and nerves was very variable. It was always present close and caudal to the subscapular vein, and either between the thoracodorsal artery or vein, or dorsal to the latter on the lateral face of the artery, or ventral to the artery on the lateral face of the vein. To the thoracic wall the node was related in such a way that it was placed directly dorsal to the deep pectoral muscle, on the scalenus primae costae muscle on a level of the third rib and third intercostal space, respectively. In one case Baum found two Lgl. axillares propriae. The Lgl. axillares primae costae, 1-2 nodes, each individual node measuring 0.75-1.5 cm in length, were located on the lateral

face of the first rib and the first intercostal space, medial to the pectoralis profundus muscle, hence covered by the latter. In most cases 2-3 nodes were observed, one of which rested directly ventral to the axillary vein on the lateral face of the first rib, while the second node was situated slightly dorsal between the axillary artery and vein on the lateral surface of the first rib or dorsal to the axillary artery in the first intercostal space. The inconstant third node could be found ventral to the axillary vein in the first intercostal space.

According to Godbille (1915), when the fore limb has been severed from the thorax, a group of lymphatic gland, the external pectoral lgls. could be seen adhering to the medial surface of the limb. The glands consisted of: (a) first, one or two glands, rather large and situated down the jugular groove in the interaxillary space, on a level of the junction of the axillary vein with the external jugular. These glands, easy to explore in the living and lean animal, have been improperly designated, according to Godbille, as axillary; the name pre-axillary would be more appropriate on account of their situation with regard to the axillary region; (b) second, there were one or two more or less voluminous glands lying against the external face of the first rib, ventral to the axillary artery and vein. These external glands corresponded to the subclavicular in man,

and not to the axillary, according to Godbille. Caudal to the axillary artery and vein and against the great dorsal adductor muscles of the arm, there was an oval flattened gland, named the sub-scapular or tracheal lgl., which was homologous to the axillary group of man, according to Godbille. He further stated that in the ox he did not find the gland on the medial face of the elbow, which was called the sus-epitrochlear in the horse and man.

Montané and Bourdelle (1917) stated that the ganglions pre-scapulaires were reduced to one elongated node, situated above the shoulder joint up to the brachiocephalicus and omotransversarius muscles. The ganglion brachial, a rather voluminous node, was situated caudal to the vessels and the insertion of the teres major muscle. The ganglions axillaires, consisted of three small nodes, as large as kidney beans, were situated under the cranial part of the ascending pectoral muscle and axillary vessels, which could be felt at the center of the thorax. These nodes did not constitute the external part of the ganglions prepectoreaux, whose one or two nodes were more voluminous than the rest, were found on the cranial border of the first rib, directly beneath the axillary vessels.

Martin (1919) described the lymph nodes of the thoracic limb essentially according to Baum's work (1912). Leighton (1927) stated that the axillary lgl. constituted a large

group, which however, were not accessible for rapid examination on the part of the meat inspector on account of the fact that they were covered by the scapula, which had to be removed in order to expose them.

von Ostertag (1932, 1934) and Grau (1943) basically described the lymph nodes of the thoracic limb concordant with Baum (1912). According to Sisson (1938) and Sisson and Grossman (1953) the axillary lgl. was located on the medial face of the distal part of the teres major on the course of the vein from the latissimus dorsi. It was oval and about 3.0 cm in length. In exceptional cases two glands might be found. Edelmann et al. (1943) stated that the axillary lgls. were situated on the medial surface of the shoulder on the dorsal border of the pectoralis profundus muscle, caudal to the shoulder joint and near the entrance of the lateral thoracic vein into the axillary.

Somers (1951) stated that the axillary lgls. in the ox were located on the medial surface on the medial scapular muscles caudal to the shoulder joint, in the midst of the brachial (axillary) vessels and nerves where these emerged from the thorax and entered the fore limb, lateral to the first or second rib. The glands were variable in number, smaller and more flattened than any other glands described so far, according to him.

The Nn. ll. axillares, according to Dobberstein and

Hoffmann (1964), consisted of two groups: (a) N. l. axillaris proprius and (b) Nn. ll. axillares primae costae, were situated lateral to the first rib and medial to the pectoralis profundus muscle. Also Schwarze and Schröder (1964) divided the Lnn. axillares into two groups: (a) the Lnn. axillares proprii and (b) Lnn. axillares primae costae. The former were situated in the neighborhood of the flexor side of the shoulder joint and medial to the teres major muscle, at the angle formed by the axillary and subscapular arteries and the latissimus dorsi and the medial head of the triceps brachii muscle, respectively. The Lnn. axillares primae costae, 1-3 in number, were situated on the axillary artery and vein, lateral to the first rib. A Ln. axillaris accessorius was located on the dorsal border of the pectoralis profundus muscle on a level of the third-fourth rib on the lateral thoracic wall.

Thornton (1968) stated that the axillary ln., known also as the brachial ln., measuring about 2.5 cm in length, was covered by the scapula. It was situated in the muscle external to and about midway along the second rib. According to Habel (1970), the axillary ln. was situated caudal to the junction of the subscapular and brachial veins and was related to the thoracodorsal vessels and to the distal end of the teres major muscle.

Koch (1970) divided the Lnn. axillares in two groups:

(a) Ln. axillaris proprius, about 3.0 cm long, lying on the medial face of the teres major muscle; (b) Lnn. axillares primae costae, 2-3 small nodes, situated on the lateral face of the first rib and laterally covered by the pectoralis profundus muscle. According to this author, in the ox the Ln. infraspinam remained to be mentioned, which was located lateral to the infraspinatus muscle and directly bordering the angle of the long head of the triceps brachii muscle, respectively. Dyce and Wensing (1971) stated that the lymph nodes of the thoracic limb comprised the larger proper axillary node, which lay against the chest wall behind the shoulder joint, and a few smaller nodes (Lnn. axillares primae costae) placed over the first rib and intercostal space.

The lymph vessels of the thoracic limb

The Lgl. axillaris propria, according to Baum (1912), in the ox received afferent vessels from the majority of the muscles of the shoulder and arm; from the muscles of the forearm, further from the trapezius, latissimus dorsi and pectorals, and cutaneus omobrachialis muscles; the fascia of the antebrachium and the superficial volar (palmar) carpal ligament; the shoulder, elbow and carpal joints; from the scapula, humerus, radius, ulna and carpus; efferents of the Lgl. infraspinata. The efferent vessels,

1-3 in number, opened into the Lgl. cervicales caudales and the Lgl. axillares primae costae. Many variations of the efferents of the Lgl. axillaris propria were observed. In one case out of six, the efferents of this node joined those of the Lgl. cervicales caudales terminating in the external jugular vein. In exceptional cases, where two Lgl. axillares propria were observed, each node released an efferent, which passed to the Lgl. axillares primae costae. In addition, both nodes were interconnected by an efferent vessel. The Lgl. axillares primae costae received afferent vessels from the pectoral muscles, serratus ventralis, transversus thoracis and scalenus (scaleni) muscles, superficial volar carpal ligament, scapula, humerus, radius, ulna, elbow and carpal joints, efferents of the Lgl. axillaris propria, and in some cases all lymph vessels as described under the Lgl. axillaris propria.

Martin (1919) stated that the afferent vessels of the Lgl. axillaris propria came for the greater part of the muscles of the shoulder and arm, muscles and fascia of the forearm, trapezius, latissimus dorsi, pectoralis profundus and cutaneus omobrachialis muscle, bones and joint from scapula to carpus, and efferents of the Lgl. infraspinata. Its efferents went to the Lgl. cervicales caudales and Lgl. axillares primae costae. The Lgl. axillares primae costae received their afferent vessels from the muscles: pectorals,

transversus thoracis and scalenus (scaleni); also partly from the muscles of the shoulder and arm; from the fascia of the forearm, the bones from the scapula to the carpus, the elbow and the carpal joint, efferents of the Lgl. axillaris propria, and in some cases also vessels which opened into the latter. Their efferents went either to the Lgl. cervicales caudales or into the thoracic duct (on the left side), or into the right tracheal trunk (on the right side).

von Ostertag (1932, 1934) and Grau (1943) in their description of the afferent and efferent vessels of the Ln. axillaris prorius and the Lnn. axillares primae costae referred to Baum's work (1912).

According to Sisson (1938) and Sisson and Grossman (1953), the axillary lgl. received afferent vessels concordant to Baum's description (1912). The efferents, 1-3 in number, went to the posterior cervical lgl. No description was given on account of the first rib axiallary lgl. Edelmann et al. (1943) stated that lymph vessels of the axillary lgl. came from the shoulder, arm and thoracic wall, while their efferents passed to the inferior cervical lgl.

Dobberstein and Hoffmann (1964) stated that the afferent vessels of the N. l. axillaris proprius came from the skin and cutaneous muscle of the shoulder region, the lateral and ventral wall of the thorax and abdomen, muscles of the shoulder and arm, scapula, humerus, latissimus dorsi,

pectoralis profundus, extensor carpi radialis and ulnaris muscles, shoulder and elbow joints, and the costal pleura. Their efferents opened into the Nn. ll. cervicales caudales, or the right tracheal trunk or the thoracic duct.

The Lnn. axillares, according to Schwarze and Schröder (1964), received afferent vessels from the skin, bones and muscles of the shoulder and arm regions, the lateral and ventral wall of the thorax and abdomen and costal pleura. Their efferent vessels terminated in the Lnn. cervicales profundi caudales, the Lnn. axillares primae costae, the right tracheal duct or the thoracic duct.

Thornton (1968) stated that the afferent vessels of the axillary ln. came from the muscles of the shoulder and thoracic limb, while its efferents passed to the prepectoral lnn. According to Koch (1970), the Ln. axillaris proprius received afferent vessels from the trapezius, latissimus dorsi, pectoralis profundus, all muscles of the thoracic limb (except the interossei), all bones of the thoracic limb, except the carpus and digits, all joints of the limb including the digitals. The efferents went to the Lnn. axillares primae costae and Lnn. cervicales caudales. The Lnn. axillares primae costae received afferents from the surrounding muscles, the bones of the thoracic limb up to the carpal joint, efferents of the Ln. axillaris proprius and Ln. infraspinam. Their efferents opened into the Lnn.

cervicales caudales or directly into the thoracic duct or into the right tracheal duct. The Ln. infraspinam received afferents from the latissimus dorsi muscle and its efferents went to the Ln. axillaris proprius.

The axillary node, according to Dyce and Wensing (1971), received afferent vessels from the bone and muscles of the upper segment of the thoracic limb, including the girdle musculature. Its efferent passed first to the accessory nodes upon the chest wall and thence to the caudal cervical group. The minor nodes (Lnn. axillares primae costae), in addition, received some afferent vessels from the chest wall. The skin and subcutaneous fascia of the shoulder, arm and forearm, and all structures of the forefoot drained directly to the superficial cervical node.

The Lymph Nodes and Lymph Vessels of the Thoracic Limb of the Sheep and Goat

The terminology of the lymph nodes of the thoracic limb of the sheep and goat used by various authors has been presented in Table 2.

The lymph nodes of the thoracic limb

Grau (1933) stated that in the sheep the Lnn. axillares (proprii), 1-2 nodes, were situated on the medial face of the teres major muscle at the angle formed by the subscapular

artery and thoracodorsal vein on one hand and the brachial artery and vein on the other. The node(s) might be found only on one side or even on both sides. The Lnn. axillares primae costae, 2-3 nodes, lying on both sides of the axillary artery and vein, at the site where the latter curved around the first rib. One node was situated on the cranial border of the vessels, hence, cranial to the first rib on the scalenus medius muscle, while the other node(s) was situated on the caudal face of the vessels on the serratus ventralis thoracis muscle. The Ln. axillaris accessorius, which apparently was rarely present and had never been described in the sheep, according to Grau, was located dorsal and caudal to the elbow joint on the lateral wall of the thorax, on the level of the costochondral joints, in the fifth intercostal space, directly next to the branches of the internal thoracic artery and vein, which supplied the pectoralis profundus muscle, and in the fifth intercostal space, close to the node, penetrated the thoracic wall into the main vessel. The Ln. cubitalis, common in man and horse, according to Grau (1934), only in 2 out of 35-40 cases, was found lying at the angle formed by the brachial and collateral ulnar veins on the medial face of the arm slightly proximal to the elbow joint, being covered by the sternocostal part of the pectoralis transversus muscle. In a third specimen Grau observed that a distinct, spindle-shaped

widening of the lymph vessels at the site typical for this node, while on the right fore limb this dilatation was absent.

According to Iwanoff (1947-1948), in the goat the Lnn. axillares proprii, consisted frequently of two nodes, the larger one measuring 1.2-1.4 cm in length, and the smaller, generally round with a diameter of 0.4-0.6 cm. They were situated on the medial side of the teres major muscle at the angle formed by the axillary and subscapular veins. The location of these nodes, however, varied in the specimens investigated. The Lnn. axillares primae costae, 2-3 in number, almost round in shape with a diameter of 0.4-0.7 cm, were located lateral on the most cranial part of the first rib. Generally, the first node was located on the lateral face of the axillary artery; the second between the axillary artery and vein; the third ventral to the axillary vein. Usually one or two nodes were situated more caudal, hence, they did not reach the first intercostal space. The Ln. cubitalis and Lnn. axillares accessorius were not found by Iwanoff.

May (1970) stated that in the sheep the Ln. axillaris was situated on the medial face on the distal part of the teres major along the course of the vein from the latissimus dorsi.

In the sheep, according to Koch (1970), a small Ln. cubitalis was observed, which was located cranial to the

Lnn. axillares primae costae. Frequently, the sheep also possessed a small Ln. axillaris accessorius, which was situated cranial to the Ln. axillaris proprius.

The lymph vessels of the thoracic limb

Grau (1933) stated that the Lnn. axillares and Lnn. axillares primae costae received afferent vessels from the region of the triceps brachii muscle. The Ln. axillaris propria also received some afferents from a part of the skin of the thoracic wall or if the node was absent, the afferents went to the Lnn. axillares primae costae. Lymph vessels coming from the shoulder and arm regions passed to the Lnn. axillares and Lnn. axillares primae costae. The vessels followed the thoracodorsal artery and vein. These nodes received also afferents from the skin of the cranial and ventral part of the chest, including the xiphoid region.

The review on the afferents of the muscles of the thoracic limb of the sheep, Grau (1934) discussed them together with the lymph vessels of the neck (see pages 75-76). Grau (1943) stated that the efferent vessels of the Ln. axillaris proprius passed to the Lnn. sternales craniales.

Iwanoff (1947-1948) stated that the Lnn. axillares proprii drained their lymph into the Lnn. axillares primae costae. The latter received afferent vessels from the fore limb and their efferents went partly to the tracheal duct or

the thoracic duct, and partly to the Lnn. cervicales profundi caudales.

The Lymph Nodes and Lymph Vessels of the Thorax and the Viscera of the Thoracic Cavity

The terminology of the lymph nodes of the thorax and viscera of the thoracic cavity as applied by the different research workers has been presented in Table 3.

The lymph nodes of the thorax and viscera of the thoracic cavity

Baum (1912) described the lymph nodes of the thorax and viscera of the thoracic cavity together, because they are not always distinctly separated from each other, especially those on the dorsal wall of the thorax. He divided the lymph nodes of the wall of the thoracic cavity into: (a) Lgl. intercostales s. thoracis dorsales, usually located at the costovertebral joints; (b) Lgl. sternales s. thoracis ventrales which were located on the inner surface of the sternum. Included in this group were the Lgl. infraspinata and Lgl. rhomboidea, present in some cases only. The lymph nodes of the viscera in the thoracic cavity were divided into the following groups: (a) Lgl. mediastinales, (b) Lgl. bronchiales, (c) Lgl. pericardiacae, (d) Lgl. diaphragmaticae.

Table 3. Terminology applied to the lymph nodes of the thorax and viscera of the thoracic cavity of the domestic ruminants

Group	Chauveau and Arloing, 1891 (ruminants)	Baum, 1912 (ox)
1	Double chain of small rounded glands on each side of dorsal column	Lgl. intercostales s. thoracis dorsales
	--	--
2	Glands at the base of the xiphoid cartilage	Lgl. sternales s. thoracis ventrales
	--	Lgl. sternalis cranialis
	--	--
	--	--
3	--	Lgl. infraspinata
4	--	Lgl. rhomboidea
5	--	Lgl. mediastinales
	--	Lgl. mediastinales dorsales
	Rudimentary glands lying beside internal thoracic vessels	Lgl. mediastinales ventrales
	Two long string of lobules on ventral surface of trachea	Lgl. mediastinales craniales
	--	Lgl. mediastinales mediae
	Small granular masses in posterior mediastinum	Lgl. mediastinales caudales
	--	Lgl. mediastinalis caudalis longissima
	--	Lgl. mediastinalis caudalis aortici
	--	Lgl. (mediastinales) diaphragmaticae

	Godbille, 1915 (ox, sheep)	Montané and Bourdelle, 1917 (ruminants)
1	Anterior intercostal lgls.	Ganglions sous-dorseaux
	Dorsoaortic or posterior intercostal lgls.	--
2	Sus-sternal lgls.	Ganglions thoraciques inferieures
	Presusternal lgl.	Ganglion sus-sternal
	--	--
	--	--
3	--	--
4	--	--
5	--	--
	--	--
	--	Ganglion sterno-diaphragmatique or xiphoidien
	Anterior mediastinal lgls.	Ganglions mediastins anterieures
	--	--
	Posterior mediastinal lgls.	Ganglions mediastins or oesophagiens posteriores
	--	--
	--	--
	--	--

Table 3 (Continued)

Group	Ghauveau and Arloing, 1891 (ruminants)	Baum, 1912 (ox)
6	Bronchial glands	Lgl. bronchiales
	--	Lgl. eparterialis
	--	Lgl. bifurcationis
	--	Lgl. bifurcationis sinistra
	--	Lgl. bifurcationis dextra
	--	Lgl. bifurcationis dorsalis
7	--	Lgl. pulmonales
	--	Lgl. pulmonales sinistrae
	--	Lgl. pulmonales dextrae
8	--	Lgl. pericardiacae
	--	Lgl. pericardiaca sinistra
	--	Lgl. pericardiaca dextra

	Godbille, 1915 (ox, sheep)	Montané and Bourdelle, 1917 (ruminants)
6	Bronchial lgls.	Two bronchial groups
	Unnamed lgl.	--
	--	--
	Left pretracheobronchial lgl.	A small tracheal group
	Right tracheobronchial lgl.	--
	Intertracheobronchial lgl.	--
7	--	--
	--	--
	--	--
8	--	--
	--	--
	--	--

Table 3 (Continued)

Group	Martin, 1919 (ruminants)	Leighton, 1927 (ox)
1	Lgl. intercostales	A number of lymphatic glands at the upper part of the thoracic wall
	--	
2	Lgl. sternales	A number of lymphatic glands at the lower part of the thoracic wall
	Lgl. sternalis cranialis	
	--	
	--	--
3	Lgl. infraspinata	--
4	Lgl. rhomboidea	--
5	Lgl. mediastinales	--
	Lgl. mediastinales dorsales	--
	Lgl. mediastinales ventrales	--
	Lgl. mediastinales craniales	Anterior mediastinal lgls.
	Lgl. mediastinales mediae	--
	Lgl. mediastinales caudales	Posterior mediastinal lgls.
	--	--
	--	--
	Lgl. (mediastinales) diaphragmaticae	--
6	Lgl. bronchiales	Bronchial glands
	Lgl. eparterialis	--
	Lgl. bifurcationes	--
	--	--
	--	--
	--	--
7	Lgl. pulmonales	--
	--	--
	--	--
8	--	--
	--	--
	--	--

	von Ostertag, 1932 (ox)	Sisson, 1938; Sisson and Grossman, 1953 (ox, sheep)
1	Lnn. intercostales s. s. thoracis dorsales	Intercostal lgls.
	--	--
2	Lnn. sternales s. thoracis ventrales	Ventral mediastinal lgls.
	--	--
	--	--
	--	--
3	--	Infraspinatus lgl.
4	--	Rhomboid lgl.
5	Lnn. mediastinales	--
	Lnn. mediastinales dorsales	Dorsal mediastinal lgls.
	Lnn. mediastinales ventrales	Ventral mediastinal lgls.
	Lnn. mediastinales craniales	Anterior mediastinal lgls.
	Lnn. mediastinales medii	--
	Lnn. mediastinales caudales	Posterior mediastinal lgls.
	--	--
	--	--
	--	Diaphragmatic lgls.
6	Lnn. bronchales	Bronchial lgls.
	--	--
	--	--
	--	--
	--	--
	--	--
7	Lnn. pulmonales	--
	--	--
	--	--
8	--	Pericardiac lgls.
	--	Left
	--	Right

Table 3 (Continued)

Group	Grau, 1943 (ruminants)	Edelmann et al., 1943 (ox)
1	Lnn. intercostales	Dorsal lgls.
	--	--
2	Lnn. sternales	Inferior thoracic lgls.
	Ln. sternalis cranialis	--
	--	--
	--	--
3	Ln. infraspinam	--
4	Ln. rhomboideus	--
5	--	Mediastinal lgls.
	--	--
	--	--
	Lnn. mediastinales craniales	--
	Lnn. mediastinales medii	--
	Lnn. mediastinales caudales	--
	Ln. mediastinalis caudalis longissimus	--
	--	--
	Lnn. diaphragmatici	--
6		Bronchial lgls.
	Ln. eparterialis	--
	Ln. bifurcationis sinister	--
	Ln. bifurcationis dexter	--
	Ln. bifurcationis medius (dorsalis)	--
7	Lnn. pulmonales	--
	--	--
	--	--
8	Lnn. pericardiaci	--
	Ln. pericardiacus sinister	--
	Ln. pericardiacus dexter	--

	Iwanoff, 1947-1948 (goat)	Somers, 1951 (ox, pigs, sheep)
1	Lnn. intercostales (Lnn. thoracici dorsales)	Intercostal lgls.
	--	--
2	Ln. sternalis (Ln. thoracicus ventralis)	Sternal lgls.
	--	--
	--	--
	--	--
3	--	--
4	--	--
5	--	Mediastinal lgls.
	Lnn. mediastinales aortici (dorsales)	--
	Lnn. mediastinales ventrales	--
	Lnn. mediastinales craniales	Anterior mediastinal lgls.
	Lnn. mediastinales medii	--
	Lnn. mediastinales caudales	Posterior mediastinal lgls.
	--	--
	--	--
	Lnn. diaphragmatici	--
6	Lnn. bronchales	Bronchial lgls.
	Ln. eparterialis	--
	Ln. bifurcationis sinistra	Left bronchial lgls.
	Ln. bifurcationis dextra	Right bronchial lgls.
	Lnn. bifurcationes medii	--
7	Lnn. pulmonales	--
	--	--
	--	--
8	Lnn. pericardiaci	--
	--	--
	--	--

Table 3 (Continued)

Group	von Ostertag and Schönberg, 1955 (ox)	Dobberstein and Hoffmann, 1964 (ox)
1	Lnn. intercostales s. thoracis	Nn. ll. intercostales
	--	--
2	Lnn. sternales s. thoracis ventrales	--
	--	Nn. ll. sternales craniales
	--	--
	--	--
3	--	--
4	--	--
5	Lnn. mediastinales	--
	Lnn. mediastinales dorsales	Nn. ll. mediastinales dorsales
	Lnn. mediastinales ventrales	--
	Lnn. mediastinales craniales	Nn. ll. mediastinales craniales
	Lnn. mediastinales medii	Nn. ll. mediastinales medii
	Lnn. mediastinales caudales	Nn. ll. mediastinales caudales
	--	--
	--	--
	--	--
6	Lnn. bronchales	Nn. ll. bronchopulmonales
	Ln. eparterialis	
	Ln. bifurcationis sinister	--
	Ln. bifurcationis dexter	--
	Ln. bifurcationis dorsalis s. medius	--
	Lnn. mediastinales bronchales	--
7	Lnn. pulmonales	--
	--	--
	--	--
8	--	Nn. ll. pericardiaci
	--	--
	--	--

	Schwarze and Schröder, 1964 (ruminants)	Stokoe, 1967 (ox)
1	Lnn. intercostales	Intercostal lgls.
	--	--
2	Lnn. sternales	Sternal lgls.
	Lnn. sternales craniales	Anterior sternal lgl.
	Lnn. sternales caudales	--
	Ln. xiphoideus	--
3	--	--
4	--	--
5	Lnn. mediastinales	--
	--	Dorsal mediastinal lgls.
	--	Ventral mediastinal lgls.
	Lnn. mediastinales craniales	Anterior mediastinal lgls.
	Lnn. mediastinales medii	--
	Lnn. mediastinales caudales	Posterior mediastinal lgls.
	--	--
	--	--
	--	Diaphragmatic lgls.
6	Lnn. bronchales	Bronchial lgls.
	Lnn. eparteriales s. tracheobronchales	Apical lgl.
	Lnn. bifurcationes sinistri	Left
	Lnn. bifurcationes dextri	Right
	Lnn. bifurcationes medii	Dorsal or middle
	--	--
7	Lnn. pulmonales	Pulmonary lgls.
	--	--
	--	--
8	--	Pericardial lgls.
	--	--

Table 3 (Continued)

Group	Thornton, 1968 (ox)	Nomina Anatomica Veterinaria, 1968 (ruminants)
1	Intercostal lnn.	Lnn. intercostales
	--	--
2	Suprasternal lnn.	Lnn. sternales
	Anterior sternal ln.	Lnn. sternales craniales
	--	Lnn. sternales caudales
	--	Lnn. phrenici
3	--	Ln. infraspinatus
4	--	Ln. subrhomboideus
5	--	--
	Subdorsal lnn.	Lnn. thoracici aortici
	Ventral mediastinal lnn.	--
	Anterior mediastinal lnn.	Lnn. mediastinales craniales
	Middle mediastinal lnn.	Lnn. mediastinales medii
	Posterior mediastinal lnn.	Lnn. mediastinales caudales
	--	--
	--	--
	--	--
6	Bronchial lnn.	--
	Apical ln.	Lnn. tracheobronchales craniales
	Left bronchial ln.	Lnn. tracheobronchales sinistri
	Right bronchial ln.	Lnn. tracheobronchales dextri
	Middle bronchial ln.	Lnn. tracheobronchales medii
7	--	Lnn. pulmonales
	--	--
	--	--
8	--	--
	--	--
	--	--

	Koch, 1970 (ox, sheep)	May, 1970 (sheep)
1	Lnn. intercostales	Lnn. intercostales
	--	--
2	--	--
	Ln. sternalis cranialis	--
	Lnn. sternales caudales	--
	--	--
3	--	--
4	--	--
5	--	--
	--	--
	Ln. xiphoideus	--
	Lnn. mediastinales craniales	Lnn. mediastinales craniales
	Lnn. mediastinales medii	Lnn. mediastinales medii
	Lnn. mediastinales caudales	Lnn. mediastinales caudales
	--	--
	--	--
	--	--
6	--	Lnn. bronchales
	Lnn. eparteriales	--
	Lnn. bifurcationes sinistri	--
	Lnn. bifurcationes dextri	--
	--	--
7	Lnn. pulmonales	--
	--	--
	--	--
8	Lnn. pericardiaci	--
	--	--
	--	--

The Lgl. intercostales, according to Baum (1912), measuring 0.4-2.0 cm in diameter, embedded in fat, were situated in the intercostal spaces (though not in each space), close to the head of the rib or cranial to it immediately under the costal pleura. The Lgl. sternales represented a group of nodes, situated in the interchondral space along the course of the internal thoracic artery and vein. Number and arrangement of the nodes varied greatly; in general, the arrangement was so that in each interchondral space only one node was found, in some cases however, two nodes were found. They were situated either on the medial face of the internal thoracic vessels, or on their dorsal surface, however, the nodes might not be found in each interchondral space. The size of the nodes ranged from about 0.5-1.0 cm in length. The Lgl. infraspinata, in the calf measuring about 0.5-1.0 cm long and 0.2-0.4 cm wide and thick, was located, embedded in fat, on the caudal border of the infraspinatus muscle on the dorsal end of the long head of the triceps brachii and medial to the latissimus dorsi, or cranial to this site immediately on the infraspinatus muscle. Baum stated that the Lgl. infraspinata was inconstant; he found only 4 times in 17 cases investigated, while in 4 other cases, 1-3 small hemal lymph nodes were found either on one or both sides at the same place or a few centimeter away from the nodes.

The Lgl. rhomboidea, in the calf measuring 1.0-1.25 cm long, was situated under the cervical part of the rhomboideus muscle, near its ventral border and the cranial angle of the scapula, about 3.0-4.0 cm from the latter. The node was inconstant, only 3 times out of 20 cases it was found. The Lgl. mediastinales, according to their location, were subdivided into the following groups: (a) Lgl. mediastinales dorsales, (b) Lgl. mediastinales ventrales, (c) Lgl. mediastinales craniales, (d) Lgl. mediastinales mediae, (e) Lgl. mediastinales caudales, to which sometimes included the Lgl. (mediastinales) diaphragmaticae. According to Baum (1912), the Lgl. mediastinales dorsales were found embedded in fat occupying the space between the dorsal face of the aorta and the body of the thoracic vertebra. They extended from the diaphragm to the cranial border of the aortic arch. On the left side the nodes, generally, were situated dorsal to the left azygos vein, while on the right side they were located on the dorsal face of the thoracic duct. Number and distribution of the nodes were, however, very variable. In adult animals the size of the nodes ranged from 1.0-3.5 cm. In their vicinity hemal lymph nodes were generally observed. The Lgl. mediastinales ventrales, 2-5 nodes, measuring 1.0-3.0 cm in length, were situated on the inner side of the transversus thoracis muscle, close to the insertion of the diaphragm to the sternum, on a level

of the sixth or seventh interchondral space. Number and location of the nodes might vary considerably. The Lgl. mediastinales craniales, according to Baum (1912), were a number of lymph nodes, which in general, were situated in the mediastinum cranial to the aortic arch, their relationship on the left and right side, however, differed slightly. On the left side Baum divided them into three groups: (a) 1-4 nodes, in the adult animal measuring 0.5-1.5 cm long, were located between the brachiocephalic trunk, the left subclavian artery, the costocervical artery and the aortic arch, respectively. They lay on the left face of the trachea and esophagus, sometimes on the left side of the longus colli muscle, and therefore, could not be distinctly separated from the Lgl. mediastinales dorsales. (b) 1-3 small nodes, 0.5-2.5 cm long, were located on the ventral border of the brachiocephalic trunk, but could also extend partly or completely on the left face of the cranial vena cava. They were situated then on the ventral face of the trachea. (c) 2-4 nodes, were located on either side of the cranial thoracic aperture between the trachea and esophagus on one side and the manubrium sterni on the other, which Baum still included in the Lgl. mediastinales, while they frequently extended slightly into the thoracic cavity, and therefore, indistinctly separated from the remaining Lgl. mediastinales craniales. They were 1-3 nodes, lying on the side of the

origin of the internal thoracic artery. Most of them measured 2.0-3.5 cm long, accompanied by 1-2 smaller nodes. On the right side a group of nodes were found, dorsal to the trachea and cranial to the aortic arch, consisting of: (a) one large node (sometimes two), almost constantly found, was situated on the dorsal face of the trachea and the right face of the esophagus, respectively, medial to the right azygos vein. Because it reached the latter cranially and caudally it was called the Lgl. venae azygos. The size of this node ranged from 4.0-7.0 cm in length; (b) caudal to the first group, 1-3 nodes, measuring 1.0-5.0 cm long, were situated on the dorsal face of the esophagus, and for a part still on the right side. They extended to the aortic arch, and could even extend caudally to the extent that they were located partly on the right side of the aortic arch, and were, therefore, included into the Lgl. mediastinales mediae; (c) 1-3 nodes were situated cranial to the right azygos vein (between it and the costocervical arterial and venous trunk) either on the right side of the trachea or still on the right side of the ventral part of the longus colli muscle. One to two nodes of this group, generally, were located immediately on the caudodorsal border of the costocervical trunk, but also between the costocervical artery and vein, therewith, could be displaced toward the cranial thoracic aperture. The Lgl. mediastinales

mediae, according to Baum (1912), were a number of nodes located on the right face of the aortic arch on the dorsal border or on the right face of the esophagus, and therefore, only visible from the right side. They were not distinctly separated from the Lgl. mediastinales craniales or caudales. There were 2-5 lymph nodes, measuring 0.5-5.0 cm in length, lying in succession or one above another. The Lgl. mediastinales caudales as designated by Baum, were a group of nodes which were situated in the mediastinum caudal to the aortic arch and ventral to the thoracic aorta. Generally, the group consisted of one large node, in the adult measuring 15.0-25.0 cm (in the calf 5.0-10.0 cm) long, almost reaching the diaphragm. Baum named it the Lgl. mediastinalis caudalis longissima. Occasionally this node could be separated into two, located one caudal to the other. Cranial to this node, 2-3 nodes (sometimes 1-4) were seen, in the adult animal 1.0-4.0 cm in length, wedged in the angle formed by the esophagus and aorta. A smaller node, measuring 1.5-2.5 cm long in the adult animal, was occasionally seen caudal to the preceding node. In most cases (but not always) one (sometimes two) node was situated on the left face of the esophagus immediately caudal to the aortic arch and in adult animals they measured 1.0-2.25 cm in length. This node obviously belonged to the Lgl. mediastinales group, and

Baum (1912) designated it as the Lgl. mediastinalis caudalis aortica. The Lgl. (mediastinales) diaphragmaticae were small nodes which occupied the thoracic side of the diaphragm, and were essentially situated on the terminal branches of the phrenic nerve or in its neighborhood or on the foramen venae cavae. The number and presence of the nodes greatly varied. Baum found up to 4 nodes in one specimen, which might even be absent in the other. In most cases one node was seen on the foramen venae cavae. The Lgl. bronchiales, as defined by Baum, were all lymph nodes located the end of the trachea, particularly at its bifurcation and on the bronchi. In the ox they were subdivided into 3 groups: (a) Lgl. eparterialis, in the adult animal 2.0-5.0 cm long, 1.5-3.0 cm wide, and 1.0-1.5 cm thick, was situated on the right face of the trachea, partly cranial and ventromedial to the origin of the tracheal bronchus, between the latter and the right azygos vein; therefore the vein partly covered the right surface of the node. Sometimes a second smaller node was seen. (b) Lgl. bifurcationis, a group of lymph nodes, located either on the left, right or dorsal face of the tracheal bifurcation, and divided into: (1) Lgl. bifurcationis sinistra, situated on the left face of the tracheal bifurcation, caudal to the ligamentum arteriosum and closely caudal to the aortic arch. The size of the node in the adult animal ranged from 2.5-3.5 cm long, 2.0-2.5 cm

wide, and 0.75-1.5 cm thick. In one case two nodes were found, situating one caudal to the other and between them a third small node was observed. These nodes had the same size mentioned above. (2) Lgl. bifurcationis dextra, in adult animals 1.0-3.0 cm long, was situated on the right face of the tracheal bifurcation and on the dorsal border of the right pulmonary artery. In about 25 percent of the cases investigated (6 out of 23) the node was absent; otherwise in exceptional cases two nodes could be found. Baum (1912) rejected the idea that the Lgl. bifurcationis dextra displaced in the depth of the lung tissue, because in the investigated cases he frequently found this node as well as the Lgl. pulmonales were either absent or both present in the same lung. (3) Lgl. bifurcationis dorsalis, situated on the dorsal face of the bifurcation or on one of the main bronchi. The Lgl. pulmonales, in the calf from pin head size to 1.0 cm long, in the adult animal 0.5-1.5 cm in length. They were again divided into the Lgl. pulmonales sinistrae, 1-2 nodes, and the Lgl. pulmonales dextrae, also 1-2 nodes. Their location varied greatly. The Lgl. pericardiacae, as defined by Baum, were several small nodes, located directly on the pericardium, and also received lymph vessels from the latter. Depending whether they were situated on the left or right side of the pericardium, Baum divided them into the Lgl. pericardiaca sinistra and dextra.

The Lgl. pericardiaca dextra, in the calf measuring 0.3-0.5 cm and in the adult animal 0.5-1.0 cm in length, and was occasionally situated on the right side of the pericardium closely to the opening of the cranial vena cava into the right atrium. The node was embedded in fat, between the pericardium and the mediastinal pleura. The Lgl. pericardiaca sinistra varied in size, but generally it measured 0.5-1.5 cm in length in the adult animal. It was situated caudoventral to the border of the aortic arch and cranial to the left azygos vein, at the site where the pulmonary artery and the left azygos vein penetrated the pericardium. Sometimes the node was very large, measuring 7.0 cm long, 2.5 cm wide, and 1.5 cm thick. Occasionally the node was absent (one out of 8 cases). Baum stated that the Lgl. pericardiacae sinistrae accessoriae were located on the site of origin of the pulmonary artery from the heart.

According to Godbille (1915), in the region of the thorax 2-3 glands were located in the vertebral groove, between the longus colli muscle and first two or three ribs, on the course of the vertebrodorsal artery. These glands were called the anterior intercostal lgls. Above the thoracic aorta and on each side of the bodies of the vertebrae, surrounded by fat, there were a series of small glands, as large as peas, which were sometimes visible under

the costal pleura. They were situated close to each intercostal artery in the interval between the vertebrocostal joints, and were called the dorsoaortic or posterior intercostal according to their location. In some cases they were divided into a dorsoaortic and an intercostal. Frequently the glands, situated opposite the eleventh and twelfth intercostal space, were large. Godbille stated that the susternal lgls. were located above the sternum and along the internal thoracic artery and vein. Their sizes varied. There might be one, two or three large ones; while others gradually reduced to fine hematic granulations or might even disappear entirely. Those most frequently found were situated below the third, fourth and fifth intercostal spaces. The presusternal lgl. was situated in the space between the cartilage of the first rib and the lateral face of the first sternebra. Further, according to Godbille, a small unnamed lymph gland was frequently found on a level of the costochondral articulation of the sixth rib, under the pleura and surrounded by a streak of fat, which corresponded to the sternodiaphragmatic gland of man. The sternopericardiac lgl. was a thoracic gland situated caudal to the apex of the pericardium, between the folds of a piece of mediastinum which remained adherent to the sternum and the diaphragm. This gland, according to Godbille (1915), was homologous to the median

diaphragmatic gland of man. He stated that the visceral lymphatic glands of the thorax consisted of: (a) the left pretracheobronchial, the most cranial bronchial gland on the left side, situated between the esophagus, aorta, bronchial trunk and trachea; (b) the corresponding gland on the right side, the right tracheobronchial, situated at the bottom of the fissure which separated the middle and cranial lobes, against the left bronchial trunk and the pulmonary vein, concealed by pulmonary tissue; (c) an unnamed lgl., situated on a level with the hilus of the right cranial lobe, and often concealed by parts of the right auricle; (d) the intertracheobronchial, situated in the angle of the bifurcation of the trachea; (e) the posterior mediastinal or esophago-aortic or posterior esophageal, situated in the caudal mediastinum; (f) anterior esophageal or tracheo-esophageal, 1-2 glands, located on a level with the bifurcation of the trachea; (g) the sub-tracheal, a single glandular mass between the trachea and the aortic arch.

The parietal lymph nodes of the thorax, according to Montané and Bourdelle (1917), consisted of: (a) ganglions sous-dorseaux, located on the dorsal part of the intercostal spaces on each side of the vertebral bodies, and related to the aorta and longus colli muscle, (b) ganglions thoraciques inferieures, situated along the course of the internal

thoracic artery and were partly covered by the transversus thoracis muscle at the ventral intercostal space. The first of this chain of nodes, ganglion sus-sternal, rather voluminous, was visible above the first sternebra and belonged to the lymph nodes of the cranial thoracic aperture. The last nodes of the chain were associated with those of the opposite side as a small group called ganglion sterno-diaphragmatique or xiphoidien, embedded in fat, which was situated above the sternum between the heart and the diaphragm. The lymph nodes of the cranial mediastinum were divided into several groups: (a) two bronchial groups, one situated mainly above the trachea, the other smaller group, located on the supplementary right bronchus, (b) a small tracheal group, situated above the trachea at the origin of both aorta, (c) several ganglions oesophagiens, usually hematic, distributed along the course of the esophagus on its dorsal border. In the caudal mediastinum there were the ganglions mediastins or oesophagiens posteriores, 3-4 in number, distributed along the dorsal face of the esophagus, caudal to the base of the heart to the diaphragm; the most caudal node was well developed, the other smaller nodes were occasionally fused with the major part as two or less distinct nodes.

Leighton (1927) listed 4 groups of lymph nodes in the thoracic cavity: (a) a considerable number of lymphatic

glands were found in relation to the ventral and dorsal part of the wall of the thorax, most of these glands being small in size. Those related to the dorsal thoracic wall rested either at the side of the bodies of the vertebrae or in the intercostal spaces. On the medial wall of the thorax a few lymphatic glands were found close to the sternum and between the costal cartilages. None of them were very large, and they were in anatomic relationship with the internal thoracic veins; (b) the anterior mediastinal lgl., situated between the folds of the cranial mediastinum; (c) the posterior mediastinal lgls., located immediately under the aortic arch; (d) the bronchial lgls., situated on either side of the trachea at the point of its bifurcation, where they were covered by the aorta, and in most animals, which have been fattened, also by a certain amount of fat.

Martin (1919) and von Ostertag (1932, 1934) described the lymph nodes of the thorax and thoracic cavity basically in agreement with Baum (1912).

Edelmann et al. (1943) stated that the submaxillary, parotid, superior cervical, middle cervical and inferior cervical lymph glands belonged also to the respiratory apparatus, because they received lymph from regions belonging in part to the digestive as well as to the respiratory apparatus. The bronchial lgls., according to these authors, were located at the bifurcation of the trachea, in

the lung tissue at the branching site of the bronchi. In the ox they formed a continuous chain with the posterior mediastinal lgls.; there were one large or several small glands to the left of the aortic arch, one on the right, at the branching of the bronchus of the cranial lobe, or at the root of the lobule of the right lobe, besides a lymph gland of the size of a hazelnut at the base of the division between the cranial and caudal lobes of the right lungs. The mediastinal lgls. consisted of the: (a) anterior mediastinal lgls. comprised numerous lymphatic glands in the precardial mediastinal space near the cranial vena cava. In the ox several large lymph glands were found above the first sternebra, near the entrance of the thorax; (b) posterior mediastinal lgls., 1-2 in number, located along the dorsal wall of the esophagus, the caudal node was conspicuously large. The lymph glands of the thoracic wall, according to Edelmann et al. (1943), comprised: (a) dorsal lgls., small glands, located to the side of the vertebrae, between the consecutive articulations of the head of the ribs, and between the layers of the intercostal muscles; (b) inferior thoracic lgls., situated on the dorsal surface of the sternum along the internal thoracic vein, i.e., between the costal cartilage and sternal articulations.

According to Dobberstein and Hoffmann (1964), the Nn. ll. intercostales were single nodes, located on a level of

the head of the ribs subpleurally, but not in all intercostal spaces. The Nn. ll. sternales were located under the transversus thoracis muscle in the first interchondral space. The Nn. ll. mediastinales dorsales, 4-5 in number, were located between the aorta and the body of the thoracic vertebrae. Dobberstein and Hoffmann did not state the presence of the ventral mediastinal lymph nodes in the ox. The Nn. ll. mediastinales craniales were located in the precardial mediastinal fold; the Nn. ll. mediastinales medii were not described in the ox. The Nn. ll. mediastinales caudales were situated close to the esophagus, caudal to the aortic arch. The Nn. ll. bronchopulmonales were situated on the bifurcation of the trachea and along the bronchi. The Nn. ll. pericardiaci were situated ventral to the opening of the cranial vena cava into the right atrium, close to the left azygos vein.

The intercostal lnn., according to Thornton (1968), also known as dorsocostal, were situated in the intercostal spaces at the junction of the ribs with their vertebrae, being covered by the intercostal muscle. Most of these nodes were small, and not all of the intercostal spaces contained a node. The subdorsal lnn. were located in the fat between the aorta and thoracic vertebrae. Though irregular in arrangement, they varied in length from 0.125-2.5 cm and frequently removed with the lungs in dressing

the carcase. The suprasternal or sternocostal lnn., according to this author, were situated between the costal cartilages and were covered by the muscle. They could be exposed by an incision 7.5 cm from and parallel to the cut surface of the sternum, and were found at the junction of the internal thoracic vein with a line continuing the caudal border of each rib. The node in the fourth intercostal space was large and readily exposed, but they were not present in every intercostal space. The largest of this group, known as presternal or anterior sternal, was superficially placed and embedded in fat on the first segment of the sternum. The bronchial lnn. consisted of two main bronchial nodes, the right and left, together with two smaller nodes. Irregular in shape and measuring 3.75 by 2.5 cm the left bronchial ln. was found close to the left bronchus, deeply embedded in fat and partly covered by the aorta. The right bronchial ln. was related to the right bronchus, smaller than the left, and partly hidden by the right lung. It was absent in 25 percent of the cases, while in some two nodes were found. The middle bronchial ln. was situated in the midline above the bifurcation of the trachea, but absent in 50 percent of cases; the apical ln. was located on the tracheobronchus where it entered the cranial lobe. A node known as the inspector's node, present in 75 percent of cases was situated at the junction of the

cranial and middle lobes of the right lung. The anterior mediastinal lnn. were numerous, lying in the mediastinal space cranial to the heart, and related anatomically to the esophagus, trachea and thoracic aorta. The posterior mediastinal lnn., 8-12 in number, were found in the fat along the dorsal wall of the esophagus. The largest and most caudal of these nodes was located caudal to the heart, being up to 20.0 cm in length and extending almost to the diaphragm. The xiphoid or ventral mediastinal lnn. were found in the loose fat at the junction of the sternum and diaphragm on a level of the sixth rib, and related anatomically to the apex of the heart; these nodes were absent in 50 percent of cases.

According to Stokoe (1967), the intercostal lgls. were situated at the dorsal ends of the intercostal spaces. The dorsal mediastinal lgls. were situated on each side of the thoracic aorta. On the right they were related to the thoracic duct, while on the left side to the left azygos vein. The ventral mediastinal lgls., according to this author, were located on the transversus thoracis muscle. The anterior mediastinal lgls. were situated at the cranial thoracic aperture and along the esophagus, trachea, cranial vena cava and brachiocephalic trunk. The posterior mediastinal lgls. were located along the esophagus from the aortic arch caudally. The diaphragmatic lgls. were situated

at the caval foramen and termination of phrenic nerves. The bronchial lgls., generally 3-4 in number, consisted of: (a) left bronchial, situated in the space between the aortic arch and the left pulmonary artery; (b) dorsal or middle bronchial might be present above the bifurcation of the trachea; (c) apical bronchial, situated at the origin of the right tracheobronchus. The inconstant pulmonary lgls., when present, were situated on the main bronchi.

The Lc. thoracicum dorsale, according to Koch (1970), consisted of: (a) Lnn. intercostales, which were located individually in the intercostal space, though not in all spaces; in this matter two nodes could be found in the neighboring intercostal space. These nodes were smaller than those in the horse; (b) Lnn. mediastinales dorsales, many middle sized nodes, located dorsal to the aorta. The sympathetic trunk passed between them and the Lnn. intercostales, according to this author. The Lc. thoracicum ventrales, comprised 2 groups: Ln. sternalis cranialis and Lnn. sternales caudales. The Ln. sternalis cranialis was situated on a level of the first intercostal space, closely cranial to the transversus thoracis muscle on the internal thoracic vessels. Two more nodes with the same names could be found closely cranial to them. The Lnn. sternales caudales were located under or on the transversus thoracis muscle. A Ln. xiphoideus was located in the region

of the xiphoid cartilage of the sternum. The Lc. mediastinale of the ox consisted of 3 groups: (a) Lnn. mediastinales craniales were located in the pericardial mediastinal fold; (b) Lnn. mediastinales medii were situated on the right face of the esophagus and on the right side of the aortic arch; (c) Lnn. mediastinales caudales were located in the concavity of the aortic arch, one of them was very large measuring 2.0 cm in length.

The lymph vessels of the thorax and the viscera in the thoracic cavity

According to Baum (1912), the Lgl. intercostales received afferent vessels from muscles of the dorsal and lateral side of the thoracic wall, pleura, ribs, thoracic vertebrae and peritoneum. In general, an efferent vessel came off from each intercostal node and opened into the Lgl. mediastinales dorsales. Many variations could occur in the origin of the efferents of the Lgl. intercostales. The afferent vessels of the muscles of the ventral and lateral thoracic wall, abdominal muscles, diaphragm, costal pleura, mediastinum, ribs, sternum, pericardium, liver, peritoneum, and efferents of the Lgl. mediastinales ventrales went to the Lgl. sternales. The efferents of these nodes opened into the Lgl. sternalis cranialis. The Lgl. infraspinata received afferent vessels from the

latissimus dorsi and its efferents went to the Lgl. axillaris propria. The Lgl. rhomboidea received afferent vessels from the supraspinatus, rhomboideus and serratus ventralis muscles, and its efferents opened into the Lgl. costocervicalis. The Lgl. mediastinales dorsales received afferents from the dorsal and lateral side of the thoracic wall, diaphragm, pericardium, spleen (in some cases), pleura, mediastinum and peritoneum, ribs, efferents of the Lgl. intercostales and Lgl. pericardiaca sinistra. Their efferents showed many variations in their formation as well as termination. The afferent vessels of the Lgl. mediastinales craniales came from the diaphragm and pericardium, costal and mediastinal pleura, and ribs. Their efferent, generally single, came off each node to open into the Lgl. sternalis cranialis. Variation and number of the efferents of the Lgl. mediastinales ventrales could occur. The Lgl. mediastinales craniales received afferent vessels from the thoracic part of the esophagus, trachea, thymus, vessels of the lungs, pericardium and heart, efferents of the nodes in the first-fourth intercostal spaces, vessels of the Lgl. eparterialis, sometimes efferents of the Lgl. sternalis cranialis, Lgl. bifurcationis sinistra, and left efferents of the most cranial part of the Lgl. mediastinales dorsales; on the right side vessels from the Lgl. mediastinales mediae and Lgl. pericardiaca dextra.

The efferents of the left Lgl. mediastinales craniales showed many variations in their termination, for instance, they opened either in another Lgl. mediastinales craniales or in the left Lgl. costocervicalis or in the left tracheal trunk. On the right side a part of the efferents passed to the right Lgl. costocervicalis, the other part to the thoracic duct. The Lgl. mediastinales mediae received afferent vessels from the thoracic part of the esophagus and trachea, lungs, efferents of the first-fourth Lgl. intercostales and Lgl. bifurcationis dextra. Their efferents, 1-2 in number, passed either to the thoracic duct or the common efferent of the Lgl. mediastinales caudales or to a Lgl. mediastinalis cranialis. The afferent vessels of the Lgl. mediastinales caudales came from the thoracic part of the trachea, lungs, pericardium, diaphragm, mediastinum and peritoneum, liver, spleen, efferents of the Lgl. pulmonales, sometimes the efferents of the Lgl. mediastinales dorsales. The efferent vessels of these nodes converged to form a large vessel, which opened into the thoracic duct. The Lgl. (mediastinales) diaphragmaticae received afferent vessels from the diaphragm and mediastinum, and their efferents, 1-2 in number, opened into the Lgl. mediastinalis caudalis longissima. The Lgl. eparterialis received its afferents from the lungs and efferent vessels of the right Lgl. pulmonales. Its efferents, 1-2 vessels, opened into the

Lgl. mediastinales craniales. The afferent vessels of the Lgl. bronchialis sinistra came from the thoracic part of the esophagus, and sometimes an efferent of the Lgl. mediastinales dorsales, efferents of the Lgl. mediastinalis aortica and Lgl. pericardiaca sinistra. Its efferents coursed either to the common efferent of the Lgl. mediastinalis caudalis aortica or those nodes located between the trachea and brachiocephalic trunk. The Lgl. bifurcationis dextra received afferent vessels from the lungs, efferents of the Lgl. bifurcationis dorsalis and Lgl. pulmonales. Its efferents opened into the Lgl. mediastinales mediae. The afferent vessels of the Lgl. pulmonales came from the lungs, which originated from all lobes but the cranial. The efferent vessels joined the deep lymph vessels of the lungs, and a part went to the left and right Lgl. bifurcationis and the Lgl. eparterialis, another part to the Lgl. mediastinales caudales. The Lgl. pericardiacae received afferent vessels from the pericardium and, in exceptional cases, from the heart.

Godbille (1915) and Montané and Bourdelle (1917) did not describe the afferents and efferents of the lymph nodes of the thorax and viscera of the thoracic cavity. According to Leighton (1927), the lymph from the rectus abdominis muscle, the cranial surface of the diaphragm and from the intercostal muscle was collected by the lymph nodes of the

upper and lower parts of the thorax. The efferents went into three directions: the mediastinal, the right tracheal trunk and the remainder into the thoracic duct. The anterior mediastinal lgls., according to this author, received afferents from the heart, pericardium and part of the diaphragm. Their efferents opened partly into the thoracic duct, partly into the tracheal duct. The afferents of the posterior mediastinal lgls. came from the mediastinum, esophagus, pleura, diaphragm, the cranial abdominal region, and from the liver. Their efferents terminated partly into the bronchial lgls. or into the anterior mediastinal lgls., and the remainder coursed to the thoracic duct. The bronchial lgls. received afferent vessels from the lungs, as well as which had already passed through the posterior mediastinal lgls.

Martin (1919), von Ostertag (1932, 1934), Sisson (1938), Grau (1943) and Sisson and Grossman (1953) basically described the afferent and efferent vessels of the thorax and viscera of the thoracic cavity in agreement with Baum (1912).

Edelmann et al. (1943), in their description on the afferents and efferents of the respiratory apparatus and the thoracic cavity, stated that the bronchial lgls. received afferent vessels from the lungs and efferents of the posterior mediastinal lgls. The efferents of the bronchials partly went to the thoracic duct and partly to the posterior

mediastinal lgls. The anterior mediastinal lgls. received afferent vessels from the heart, pericardium, thymus, thoracic wall, mediastinum and diaphragm. Their efferents went to the thoracic duct or the cranial vena cava. The posterior mediastinal lgls. received afferent vessels from the esophagus, pericardium, diaphragm, mediastinum and parietal surface of the liver. Their efferent vessels opened into the bronchial nodes or the anterior mediastinal lgls. or the thoracic duct. The dorsal lgls. of the thoracic wall, according to Edelmann et al. (1943), received afferent vessels from the thoracic vertebrae, muscles of the dorsal wall of the thorax, pleura, diaphragm and intercostal muscles. Their efferents terminated in the thoracic duct. The inferior thoracic lgls. received their afferents from the rectus abdominis and transversus abdominis muscles, thoracic and intercostal muscles, pleura and diaphragm. Their efferents went to the cisterna chyli or the inferior cervical lgls.

According to Somers (1951), the intercostal lgls. in the ox received afferent vessels from the intercostal muscles, the dorsal muscles, thoracic vertebrae, parietal pleura, and partly from the periosteum and the diaphragm. The efferents coursed forward and opened into the mediastinal lgls. or into the thoracic duct. The afferent vessels of the sternal lgls. came from the rectus abdominis and intercostal

muscles, parietal pleura and diaphragm. Their efferents opened into the prepectoral lgls. or into the tracheal trunk on the right side or into the thoracic duct on the left. The right bronchial lgl. received afferent vessels chiefly from the lung, thoracic part of the esophagus and the heart. The efferents opened into the mediastinal lgls. The anterior mediastinal lgls., according to Somers (1951), received afferent vessels from the pleura, esophagus, pericardium and heart, and efferents of the bronchial lgls., thymus and small lymph glands along the phrenic nerve. Their efferents passed either to the thoracic duct and tracheal trunk, or to the prepectoral, before entering the large lymphatic trunk. The posterior mediastinal lgls. received afferent vessels from the esophagus, lungs, pericardium, mediastinum, peritoneum, liver, efferents of the right bronchial, and the spleen. The efferents of the posterior mediastinal lgls. opened into the thoracic duct.

Dobberstein and Hoffmann (1964) stated that the afferent vessels of the Nn. ll. intercostales came from the muscles of the trunk, the ribs, scapula and its cartilage, costal pleura, mediastinum and diaphragm. Their efferents went to the mediastinal lymph nodes and the thoracic duct. The afferent vessels of the Nn. ll. sternales craniales came from the muscles of the thoracic wall, ribs, sternum, trachea, esophagus, thymus, pericardium, pleura, diaphragm and liver.

Their efferents went to the mediastinal lymph nodes and the thoracic duct, respectively, or to the right tracheal trunk. The Nn. ll. mediastinales dorsales received afferent vessels from the thoracic vertebrae, muscles and bones of the thoracic wall, mediastinum, aorta and liver. Their efferents passed to the thoracic duct, sometimes to the mediastinal lymph nodes. The afferents of the Nn. ll. mediastinales craniales, according to Dobberstein and Hoffmann (1964), came from the thoracic part of the trachea and esophagus, thymus, lungs, heart and pericardium. Their efferents opened into the thoracic duct or tracheal trunk. The Nn. ll. mediastinales caudales received afferent vessels from the esophagus, mediastinum, pericardium, diaphragm, peritoneum, liver and spleen. The efferents of these lymph nodes passed to the thoracic duct. The afferent vessels of the Nn. ll. bronchopulmonales came from the trachea, bronchi, lungs, except the apical lobe of the right lung, pericardium, heart, esophagus and mediastinum. Their efferents coursed to the Nn. ll. mediastinales craniales (those of the Nn. ll. pulmonales through the Nn. ll. bifurcationes) or directly to the thoracic duct. The Nn. ll. pericardiaci received afferent vessels from the heart and pericardium, and their efferents passed to the neighboring nodes.

According to Stokoe (1967), the intercostal lgls.

received afferent vessels from the muscles of the dorsal and lateral thoracic wall, peritoneum, thoracic vertebrae and ribs; their efferents went to the mediastinal lgls. The dorsal mediastinal lgls. received afferent vessels from the same structures drained by the intercostals, in addition, from the diaphragm, mediastinum, pericardium and intercostal lgls. Their efferents passed to the thoracic duct or joined the common duct of the posterior mediastinal lgls. The ventral mediastinal lgls. received afferent vessels from the costal and mediastinal pleura, diaphragm, pericardium and ribs. Their efferents united to form a trunk, which passed to the sternal lgls. The anterior mediastinal lgls. received afferent vessels from the thoracic esophagus, trachea, thymus, lungs, pericardium, heart, costal and mediastinal pleura, the first four intercostal lgls., and nodes on the tracheal bronchus. Their efferents passed to the thoracic duct, right tracheal trunk and costocervical lgl.

The afferent vessels of the posterior mediastinal lgls. came from the esophagus, lungs, pericardium, mediastinum, peritoneum, liver and spleen. Their efferents united to form a common duct which emptied its lymph into the thoracic duct. The diaphragmatic lgls. received afferent vessels from the diaphragm and mediastinum, and their efferents went to the posterior mediastinal lgls. The bronchial lgls. received afferent vessels from the lungs, pulmonary

lgls., thoracic esophagus and heart; their efferents passed to the common duct of the posterior mediastinal, middle mediastinal or anterior mediastinal lgls. The pulmonary lgls. received afferent vessels from the lungs, and their efferents passed to the bronchial and posterior mediastinal lgls. The pericardial lgl. received afferents from the pericardium, and its efferents went to the anterior mediastinal, left bronchial and apical lgls. The afferent vessels of the sternal lgls. came from the muscles of the ventral and lateral side of the diaphragm, pleura, pericardium, peritoneum, liver, ribs, costal cartilage, sternum and ventral mediastinal lgls. Their efferents passed to the anterior mediastinal lgls. or to the termination of the right tracheal trunk on the right and to the thoracic duct on the left.

According to Thornton (1968), the intercostal lnn. received afferent vessels from the dorsal region, intercostal muscles, ribs, and parietal pleura. Their efferents went to the mediastinal lnn. The subdorsal lnn. received afferent vessels from the same structures as intercostals, mediastinum, pericardium, diaphragm and efferents of the intercostal lnn. Their efferents went to the thoracic duct. The suprasternal lnn. received afferent vessels from the diaphragm, abdominal and intercostal muscles, parietal and visceral pleura, and peritoneum. Their efferents went to

the thoracic duct or the prepectoral lnn. The left bronchial ln. discharged their lymph into the thoracic duct; the right bronchial ln. into the posterior mediastinal lnn. or thoracic duct; the middle bronchial and apical lnn. into the anterior mediastinal lnn. The anterior mediastinal lnn. received afferent vessels from the heart, pericardium, mediastinum and thoracic wall, efferents of the apical and middle bronchial. Their efferents went to the thoracic duct. The posterior mediastinal lnn. received afferents from the lungs, diaphragm, peritoneum, surface of the liver and spleen. Their efferents passed to the thoracic duct.

Koch (1970) stated that the afferent vessels of the Lnn. intercostales came from the muscles and fascia of the trunk, the ribs, thoracic and lumbar vertebrae, scapula and its cartilage, the dorsal half of the costal pleura, the peritoneum of the intrathoracic abdominal cavity and the lateral abdominal wall. Their efferents passed to the thoracic duct or the neighboring lymph nodes in the mediastinum. The afferents of the Lnn. mediastinales dorsales came from the muscles and fascia of the thoracic wall, the ribs and their vertebrae, mediastinal pleura, aortic wall, efferents of the Lnn. intercostales, pericardium, frequently the spleen, liver, dorsal costal pleura, precardial mediastinum, intrathoracic peritoneum, efferents of the Lnn. intercostales and Lnn. pericardiaci. Their

efferents opened into the thoracic duct or into the Lnn. mediastinales caudales. The afferent vessels of the Ln. sternalis cranialis, according to Koch, came from the ventral thoracic and abdominal muscles, diaphragm, pleura of the ventral half of the thorax, ribs and their cartilages, sternum, pericardium and liver. Its efferents opened into neighboring nodes or the thoracic duct or the right tracheal trunk. The afferent vessels of the Lnn. sternales caudales came from the ribs, diaphragm, pericardium, pleura of the ventral half of the thorax and postcardial mediastinum. Their efferents resembled the Ln. sternalis cranialis. The Lnn. mediastinales craniales received afferent vessels from the esophagus, lungs, heart, pericardium, mediastinum and their lymph nodes. Their efferents opened directly or through neighboring nodes into the thoracic duct. The afferents of the Lnn. mediastinales mediae came from the same region as the Lnn. mediastinales craniales, with the exception of the heart and pericardium. Their efferents passed to the thoracic duct. The Lnn. mediastinales caudales received afferent vessels from the postcardial mediastinum, pericardium, esophagus, peritoneum, spleen, liver and efferents of the Lnn. mediastinales mediae and Lnn. pulmonales. Their efferents passed directly or via neighboring nodes to the thoracic duct. The Lnn. bronchales received afferent vessels from the trachea, heart, a part of the esophagus

and efferents of the Lnn. pulmonales. Their efferents went to the thoracic duct or Lnn. mediastinales mediae or craniales. The Lnn. pulmonales received afferent vessels from the lungs, and their efferents went to the Lnn. bronchales or the Lnn. mediastinales caudales. The Ln. eparterialis received afferents from the lungs, and its efferent vessel passed to the Lnn. mediastinales craniales. The afferent vessels of the Lnn. pericardiaci came from the pericardium and heart, and their efferents opened into the Lnn. mediastinales dorsales and Lnn. mediastinales dorsales, Lnn. mediastinales craniales or Ln. eparterialis.

Sisson and Grossmann (1953) stated that the terminal part of the thoracic duct was often ampullated, but the lymphaticovenous system opening was small. The duct received efferent vessels of the intercostal, mediastinal and bronchial lnn.

According to Dyce and Wensing (1971), in the ox the thoracic duct arose from the cisterna chyli and entered the thorax along the right side of the aorta. It inclined ventrally over the right face of the aortic arch and then crossed the left aspect of the trachea within the pericardiac mediastinum. It opened in the cranial vena cava or on its tributaries. Often the duct was duplicated for all parts of the course.

The Lymph Nodes and Lymph Vessels of the Thorax and the Viscera of the Thoracic Cavity of the Sheep and Goat

The terminology of the lymph nodes of the thorax and viscera in the thoracic cavity as applied by various authors has been presented in Table 3.

The lymph nodes of the thorax and viscera of the thoracic cavity

According to Godbille (1915), the lymph nodes of the thorax and viscera of the thoracic cavity of the sheep resembled the ox with following few remarks. The dorsoaortic lgls. were well developed and were found in a great number, while the intercostals were seldom observed. The presusternal were voluminous and the susternals were represented by small granules.

Grau (1933) stated that in the sheep the Lc. thoracale ventrale consisted of the Lnn. sternales, 1-3 in number, located on the inner surface of the sternum in the region of the costal cartilage and the internal thoracic vessels. Generally, one of them, Ln. sternalis cranialis, was situated in the first intercostal space or medial to the second costal cartilage, embedded in fat, and in all cases cranial to the cranial border of the transversus thoracis muscle.

The Lc. thoracale dorsale in the sheep, according to Grau (1934), comprised the Lnn. intercostales. They were

small nodes, located on a level of the joints of the head of the rib, in all cases, however, dorsolateral to the sympathetic trunk, embedded in fat, under the pleura and the endothoracic fascia. Seldom a few nodes were located more laterally on the level of the angle of the ribs, which Grau also included into the Lnn. intercostales. Not all intercostal spaces were occupied by the Lnn. intercostales. The Lc. mediastinale consisted of the Lnn. mediastinales craniales, medii, caudales and Lnn. mediastinales dorsales (aortici). In his work Grau emphasized only on the latter. The Lnn. mediastinales dorsales (aortici) were located in different intercostal spaces on a level with the body of the thoracic vertebrae, mostly more or less directly on the aorta or on the left azygos vein under the pleura. Grau included only those nodes in this group which were located medial to the sympathetic trunk.

According to Iwanoff (1947-1948), in the goat the Ln. rhomboideus was found in one of his specimens, that too on one side. It was a small node with a diameter of 0.15 cm, located medial to the rhomboideus muscle and the cranial angle of the scapula. The Lnn. intercostales (Lnn. thoracici dorsales), the cranial and caudal nodes were generally small, measuring 0.2-0.4 cm in diameter, round in shape, while the middle ones were usually ellipsoidal or bean-shaped with a length of 0.6-1.6 cm. They were up to six in number. They

were located between the head of the ribs and the body of the thoracic vertebrae, or at the beginning of the intercostal spaces and covered by the pleura. Not all intercostal spaces were occupied by an intercostal node. The Ln. sternalis (Ln. thoracicus ventralis), one on each side of the thoracic cavity, measuring 1.0-1.7 cm in length, was situated at the same site as the Ln. sternalis cranialis of the sheep (Grau, 1933). The Lnn. mediastinales dorsales (aortici), 5-7 in number, generally situated dorsal or dorsolateral to the aorta, on the left side between the latter and the left azygos vein, while on the right between the aorta and the thoracic duct. In some cases they were found close to the lateral surface of the rib, separated by the sympathetic trunk. In the region of the ninth-twelfth intercostal space some nodes were not exactly situated along the aorta; however, according to Iwanoff (1947-1948), they should be included to the dorsal mediastinal group. The shape and size of the Lnn. mediastinales dorsales (aortici) varied; if round they measured 0.2-0.8 cm in diameter, if oblong 0.6-1.4 cm in length. The Lnn. mediastinales ventrales, inconstant nodes, situated above the transversus thoracis muscle, if present. In one specimen 2 small nodes were observed, measuring 0.2 cm in diameter, lying on a level of the third left costal cartilage. In another goat one node was seen on the right side

caudal to the fourth cartilage. The Lnn. mediastinales craniales were usually located between the aorta and cranial thoracic aperture in the pericardial mediastinal fold. Their number and position on either side of the body varied. Generally, on the left side 2-3 nodes were seen, measuring 0.7-0.8 cm in length, and the largest 1-2 nodes having a diameter of 0.2 cm. On the right side 3-6 nodes were seen, measuring 0.7-1.0-3.0 cm in length. In one case some nodes were found dorsal to the esophagus, in the neighborhood of the longus colli muscle, which was difficult to determine whether they belonged to this group or the Lnn. mediastinales aortici. In another case only one node was found in the precardial mediastinal fold, situated in the region of the first rib, and Iwanoff included it into the nodes of the cranial thoracic aperture. The Lnn. mediastinales medii, 1-3 nodes of various length, ranging from 0.4-0.6-3.5 cm, were situated to the right of the aortic arch along the dorsolateral border or on the right face of the esophagus. The Lnn. mediastinales caudales were located between the dorsal border of the esophagus and the ventral surface of the aorta, extending from the aortic arch to the surface of the diaphragm. The left and right nodes, according to Iwanoff, fused together into a single node, measuring 9.5-15.0 cm long and 1.5-1.7 cm wide. Small hemal lymph nodes were observed lying along this node, on

the left side in the region of the seventh or eighth intercostal space, the eighth or ninth on the right. In addition, 1-3 hemal lymph nodes, 0.8-1.2 cm long, were seen situated cranially or caudally to the large one, or frequently located on the left wall of the esophagus. The Lnn. bronchales, situated on the lateral side of the trachea and on its bifurcation, were divided as follows: (a) Ln. eparterialis, small, almost round lymph node with a diameter of 0.3-0.5 cm, was situated at the origin of the tracheal bronchus, cranial or ventrocaudal to it. In the young animal investigated a large node, measuring up to 4.6 cm, was seen dorsal to the cranial vena cava between the ventral border of the trachea and the ventral face of the esophagus, respectively; (b) Lnn. bifurcationes, were located close to the bifurcation of the trachea and consisted of: (1) Ln. bifurcationis sinistra, most cranial one measuring 1.5-3.3 cm long, was situated to the left of the bifurcation between the left bronchus and the aortic arch. Another smaller node might be observed in the neighborhood of the first one; (2) Lnn. bifurcationes medii (usually one node) measuring 0.2-1.1 cm long, were situated dorsally on the bifurcation, or directly caudal to it. Occasionally two nodes were observed; (3) Ln. bifurcationis dextra, with an average length of 0.5 cm, was located on the right of the bifurcation. Occasionally two nodes were seen, however, fused together to

form a small node. Lnn. pulmonales, small inconstant nodes, were located near the left and right main bronchus, covered by fine connective tissue. Lnn. pericardiaci, also inconstant, were located on the dorsal part of the pericardium. On the left side one node, measuring 0.8-1.0 cm long, was situated above the phrenic nerve, cranial to the termination of the left azygos vein. A much smaller node, situated farther away than the first one, was seen dorsal to the phrenic nerve. The Lnn. diaphragmatici were not observed. In the thoracic cavity hemal lymph nodes were frequently observed, mainly in the neighborhood of the intercostals, aortic mediastinals, cranial and caudal mediastinals, and bronchials, as well as in other places, such as the base of the pericardium and the cranial thoracic aperture. Their size varied, if round, 0.2-0.4 cm in diameter, or if oblong, 0.7-1.1-1.2 cm in length. Occasionally large hemal lymph nodes were seen.

In the sheep, according to May (1970), the Lnn. intercostales, usually one very small node, were situated at the dorsal end of each intercostal space. Among the Lnn. sternales the largest of them, overlying the first or second segment of the sternum, was 2.0 cm long. It was embedded in fat at the cranial border of the transversus thoracis muscle. The Lnn. mediastinales dorsales were located on each side of the aorta in the fat filling the space between the

aorta and the thoracic vertebrae. The lymph nodes increased in size towards the aortic hiatus of the diaphragm. Numerous hemal lymph nodes were observed in this region. The Lnn. mediastinales craniales, 2-3 very small and pea-shaped nodes, were located along the brachiocephalic trunk. The Lnn. mediastinales caudales, two nodes, were located between the esophagus and diaphragm ventrally, and the aorta dorsally. The larger node lay caudal and about 7.0-10.0 cm long. The smaller cranial node was about 1.0 cm long and was situated on the ventral surface of the aorta.

The lymph vessels of the thorax and viscera of the thoracic cavity

According to Grau (1933), in the sheep lymph vessels, between the xiphoid process as well as those entering the thoracic cavity under the transversus thoracis muscle, followed the course of the internal thoracic vessels and opened into the Lnn. sternales. Lymph vessels, which penetrated the thoracic wall between the costal arches and the xiphoid process, arrived at the dorsal face of the transversus thoracis muscle, and also vessels from the latter, passed to the Lnn. sternales.

The Lnn. sternales, Lnn. intercostales and the Lnn. mediastinales dorsales (aortici) received lymph vessels from muscles of the neck up to the cranial border and under

the scapula (Grau, 1934).

Iwanoff (1947-1948) stated that the efferents of the Lnn. intercostales partly passed cranially to the Lnn. mediastinales craniales or Ln. costocervicalis; the other part went caudally to the Lnn. mediastinales aortici or opened directly into the thoracic duct of the goat. The Lnn. mediastinales aortici released their efferents partly to the Lnn. mediastinales caudales and partly directly into the thoracic duct. The Ln. sternalis received afferent vessels from the Lnn. mediastinales ventrales; the efferents passed to the thoracic duct on the left side, and to the cranial nodes of the Lnn. mediastinales craniales on the right side of the body. The efferents of the Lnn. pericardiaci opened into the Lnn. bifurcationes, Lnn. mediastinales medii and craniales. The Lnn. bronchales, including the Ln. eparterialis released their efferent vessels partly to the thoracic duct (on the right side) and partly to the Lnn. mediastinales medii and caudales. The Lnn. mediastinales released their efferents partly to the thoracic duct and partly to the other nodes of the group, namely the Lnn. mediastinales caudales (on the right side) to the thoracic duct; Lnn. mediastinales medii to the thoracic duct (on the right side) and to caudal nodes of the Lnn. mediastinales craniales; Lnn. mediastinales craniales either to the thoracic duct or the tracheal trunk or to lymph nodes located

at the cranial thoracic aperture or into the Ln. costo-cervicalis.

In the sheep May (1970) did not describe the afferents and efferents of the Lnn. intercostales, Lnn. mediastinales dorsales and Lnn. mediastinales craniales. The efferents of the Lnn. mediastinales caudales, according to May, joined the thoracic duct or the Lnn. mediastinales craniales.

Iwanoff (1947-1948) reported that in the goat the thoracic duct was a continuation of the cisterna chyli which followed the dorsolateral face of the aorta until the fifth thoracic vertebra, beyond this level it turned to the left (between the third and fifth thoracic vertebra) and opened into the cranial vena cava or the left jugular vein.

In the sheep (May, 1970) the thoracic duct arose at the cisterna chyli, related to the right and dorsolateral face to the aorta near the diaphragm, passed cranially with the aorta until the level of the sixth thoracic vertebra, when it turned obliquely ventral to the left and opened into the external jugular vein; its termination was ampullated, though the actual opening into the venous system was very constricted. As it approached the jugular vein, it received numerous branches--left tracheal (sometimes right tracheal), and left and right axillary ducts; it might also divide into two vessels over a variable distance to the join immediately before the ampullated termination.

MATERIAL AND METHODS

Eleven goats, consisting of six males and five females of various breeds, were used in this study. Their ages varied from 4 to 7 years and weight ranged from 40-50 kg in the female, and between 75-100 kg in the male. Additional information was obtained from the heads of five goats and five sheep dissected by the freshmen students of the professional veterinary curriculum at the Department of Veterinary Anatomy, College of Veterinary Medicine, Iowa State University, Ames, Iowa.

Preliminary experiments in rats and dogs were conducted in depicting the pattern of the lymph drainage according to the known methods used by several investigators accessible in the literature (Gerota, 1896b, modified by Baum, 1912 and by Reiffenstuhl, 1964; Sugimura et al., 1955; and Rusznyak, 1960; Saar and Getty, 1962-1963). The purpose of these experiments was to make a comparative evaluation of various methods and to establish the best suited injection technique for our existing facilities.

Evans blue[1] was preferred as color medium on the basis of the aforementioned preliminary studies in rats and dogs. To obtain maximal results of the injection in the goat, dog or sheep serum or egg white was added to the dye solution

[1]Evans blue, Chroma 10715, Chroma-Gesellschaft, Schmid and Co., Stuttgart-Untertukheim, Germany. Distributed by Roboz Surgical Instrument Co., Inc., Washington, D.C.

(Table 4).

The specimen were prepared according to the following procedure. Feed was withheld from the animals for two to three days prior to the preparation of the specimens. Water was given ad libitum. The animals were anesthetized with a sodium pentobarbital solution,[1] 1.0 cc/2.27 kg (5 lbs.) body weight. The hair was shaved with a large animal clipper and the dye solution was injected. A 6 cc plastic syringe and 26G 3/8 inch, 25G 5/8 inch and 22G 1.5 inches needles were used for the injection. The animals were injected with 0.5-1.0 cc dye solution intracutaneously, subcutaneously, intra-articularly and intramuscularly, and 10.0-15.0 cc intra-thoracically at predetermined places in the regions of the head, neck, thoracic limb, thoracic wall and thoracic cavity.

In three specimens (No. 4, 5 and 6; Table 4) 30 to 45 minutes after the injection was completed, the thoracic wall was incised at the fourth intercostal space to clamp the cranial vena cava, thus preventing the dye solution from the lymph vessels flowing back into the venous system.

One to one hour and a half after injection the animals were killed by exsanguination through the femoral

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[1]Toxital (178.0 mg pentobarbital sodium per cc aqueous solution) by Jensen Salsberry Laboratories, Kansas City, Missouri and Sodium pentobarbital solution (1 gr pento-barbital sodium per cc aqueous solution) by Veterinarian Specialities Inc., Cedar Rapids, Iowa

Table 4. Dye preparations used for the injection of the lymphatic system in the goat

Specimen No.[a]	Evans blue (in gm)	Phys. NaCl (in cc)	Serum in cc		Egg white (in cc)	Remarks
			Dog	Sheep		
1	2	100	100	--	--	
2	2	100	100	--	--	
3	1	100	--	100	--	
4	2	100	--	100	--	Thorax incised
5	2	100	--	--	--	Ditto
6	5	100	--	--	--	Ditto
7	2	100	--	--	30	
8	2	100	--	--	50	
9	2	100	--	--	30	
10	2	100	--	--	30	
11	2	100	--	--		

[a]Specimen No. 1-6 were anesthetized with Toxital; specimen No. 7-11 with sod. pentobarb., Vet. Spec. Inc.

artery. To preserve the specimen regular embalming fluid[1] of the Department of Veterinary Anatomy, College of Veterinary Medicine, Iowa State University, was used. The specimen was kept in a cooler between 2^{o}-4^{o}C until they were dissected.

Two hearts and lungs, obtained from additional animals, were injected in vitro, using a respirator to simulate the actual respiratory movements (Baum, 1912).

The lymph nodes and lymph vessels were exposed by routine gross dissection. Fluorescent lights with magnifier[2] were used to identify the small lymph vessels. Histological sections of tissue, taken from specimens, were made routinely and examined to clarify confusion due to close proximity of the lymph nodes with other structures, e.g., the pterygoid ln. of the ox in the area of the dorsal buccal glands, and the cranial deep cervical ln. in the area of the cervical thymus, etc. The lymph nodes were measured by a Graf Apsco (Chicago) 15.0 cm long plastic ruler with the help of a curved hemostat, especially for the thickness. The mean and standard deviation were determined with a digital computer model

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[1]Formula: Isopropyl alcohol, 60%; formalin, 4%; phenol, 6%; corn syrup, 2.5%; and water, 27.5%.

[2]Fluorescent light with magnifier, Model UL-M-210 made by Dazor Mfg. Corp., St. Louis, Missouri and Strat-O-Lite, Inspection magnifier made by Strat-O-Seal, 3039 W. Fullerton, Chicago, Illinois.

pdp/8e.[1] The composite findings of the dissections were presented in eleven illustrations. Photographs were taken throughout the course of dissection work, using a Canon FT camera, f/1.8 and Soligor close-up lenses, with Kodak Panatomic-X, B&W film, ASA 32 for the black and white and Kodak Ektacolor, Type S, Professional Negative Film, ASA 100, with a Vivitar 80B correction filter, for the colored. The latter were commercially developed and printed.

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[1]Digital Equipment Corporation, Maynard, Massachusetts.

RESULTS AND DISCUSSION

The abbreviations used in the Review of Literature were also applicable in this section. The number and letters in parentheses after each anatomic structure referred to the figures, except where otherwise indicated.

The Lymph Nodes and Lymph Vessels of the Head

Results

There were three lymphocenters in the head region of the goat: 1. parotid lc. consisting of the parotid ln.; 2. mandibular lc. comprising the mandibular ln; and 3. retropharyngeal lc. including the lateral and medial retropharyngeal lnn.

The number and average of the lymph nodes in each group and on an individual specimen were presented in Table 5.

1. Parotid lymphocenter

   a. Parotid lymph node (1/1 and 5/1)

      Location: In the parotid region, being completely covered by the parotid gland; approximately 0.5-1.0 cm caudal to the caudal border of the masseter muscle.

      Number: One on each side of the head in majority of cases. In three specimens (No. 2, 7 and 10) two nodes were present; in No. 2 they were observed bilaterally,

Table 5. Number of lymph nodes in each group of the head of the goat

Group of lymph node(s)		Specimen No. 1	2	3	4	5	6	7	8	9	10	11	Total	Average[a]
Parotid	R[b]	1	2	1	1	1	1	2	1	1	1	1	26	1.18±0.39
	L[b]	1	2	1	1	1	1	1	1	1	2	1		
Mandibular	R	1	1	1	1	1	1	1	1	1	1	1	22	1.00±0.00
	L	1	1	1	1	1	1	1	1	1	1	1		
Lateral retropha-ryngeal	R	3	2	3	2	2	2	3	2	2	2	2	47	2.14±0.55
	L	1	2	2	2	1	2	3	2	2	2	3		
Medial retropha-ryngeal	R	1	1	1	1	1	1	2	1	1	1	1	26	1.18±0.65
	L	1	1	1	1	1	1	4	1	1	1	1		
Total of each side	R	6	6	6	5	5	5	8	5	5	5	5		
	L	4	6	5	5	4	5	9	5	5	6	6		
Total of both sides		10	12	11	10	9	10	17	10	10	11	11	121	11.00±2.05[c]

[a] Mean and standard deviation of lymph nodes on an individual side.

[b] R = right side; L = left side.

[c] Average number of lymph nodes on an individual specimen.

while in No. 7 and 10 unilaterally.

Size: (1.2-5.0) cm long, (0.8-2.0) cm wide, and (0.5-1.5) cm thick.

Shape: Oval, circular or irregular with rounded borders.

Relation: Lateral: Lobules of the parotid gland, dorsal buccal branch and the auricular palpebral nerve of the facial nerve.

Medial: Transverse facial artery and vein, and superficial temporal vein.

Dorsal: Tragus of the ear.

Ventral: Lobules of the parotid gland, and the caudal border of the masseter muscle.

Afferent: From the skin and structures of the nasal, facial, palpebral, external ear and masseteric regions, and parotid gland.

Efferent: To lateral retropharyngeal lnn.

Remarks: When two nodes were present they were situated somewhat dorsal to the other, and in that case the dorsal buccal branch of the facial nerve passed between them.

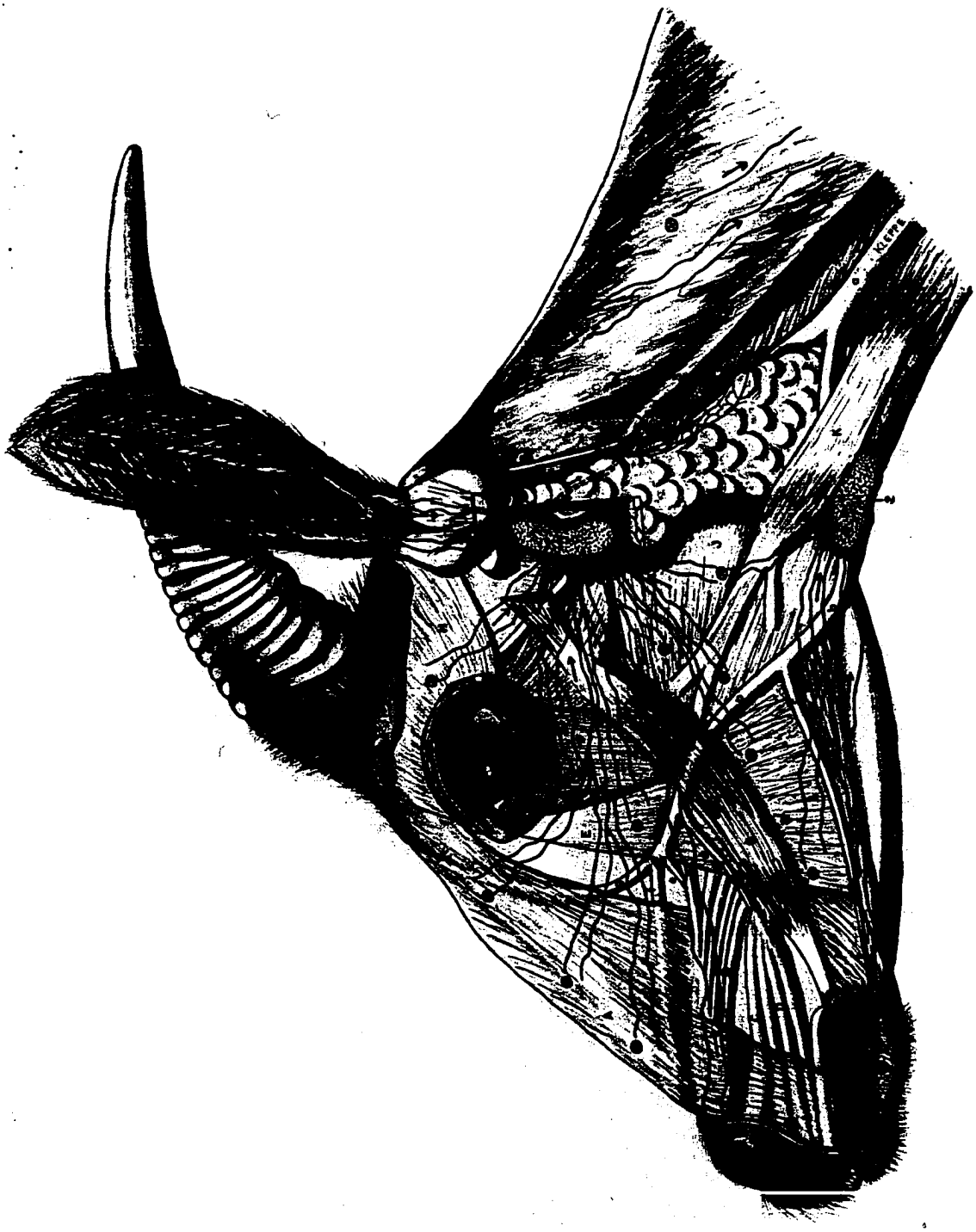
The dorsally coursed auricular palpebral

Figure 1. Lymph nodes and lymph vessels of the head of the goat. ⊗ Injection sites

1 Parotid ln.; 2 Mandibular ln.; 3, 3' Lateral retropharyngeal lnn.

A Levator nasolabialis m.
B Levator labii maxillaris m.
C Caninus m.
D Depressor labii maxillaris m.
E Malaris m.
F Malaris m. (Depressor palpebrae inferioris part)
G Zygomaticus m.
H Buccal part of buccinator m.
I Depressor labii mandibularis m.
J Masseter m.
K Sternomandibularis m.
L Zygomatoauricularis m.
M Frontalis m.
N Cleidooccipitalis m.

a External jugular vein
b Facial vein
c Labial mandibular vein
d Labial maxillary vein
e Lateral nasal vein
f Dorsal nasal vein
g Angularis oculi vein
h Caudal auricular vein (cut)



nerve of the facial penetrated the dorsal node. No hemal lymph nodes were found in the vicinity of the parotid ln.

2. Mandibular lymphocenter

a. Mandibular lymph node (1/2; 5/2 and 6/1)

Location: Along the ventral border of the molar part of the mandible, approximately halfway between the incisura vasorum facialium and the angle of the mandible, at the junction of the lingual and facial veins.

Number: One on each side of the head.

Size: (1.7-3.5) cm long, (1.0-2.2) cm wide, and (0.4-0.8) cm thick.

Relation: Lateral and Ventral: The fascia of the platysma next to the skin.

Medial: Rostral belly of the digastricus muscle.

Dorsal: Ventral border of the molar part of the mandible.

Afferent: From the skin and structures of the mandibular space, including the gum of the mandible, tongue, mandibular gland and caudoventral part of the masseter muscle.

Efferent: Two to three vessels (7/h) usually coursed under the parotid gland to the lateral retropharyngeal lnn. In one specimen (No. 3) an efferent vessel (7/f) went to the medial retropharyngeal ln.

Remarks: Hemal lymph nodes were found in some specimen.

3. Retropharyngeal lymphocenter

a. Lateral retropharyngeal lymph nodes (1/3,3'; 3/1 and 4/2)

Location: At the dorsal side of the proximal part of the neck, ventral to the wing of the atlas, usually surrounded by a variable amount of fat. They were covered by the aponeurosis of the cleidooccipitalis muscle on the caudal border of the parotid gland.

Number: Two to three nodes on each side of the head. In specimens No. 1 and 5 one node was seen only on the left side.

Size: (0.7-2.8) cm long, (0.4-2.7) cm wide, and (0.3-0.9) cm thick.

Shape: Oval, flattened,

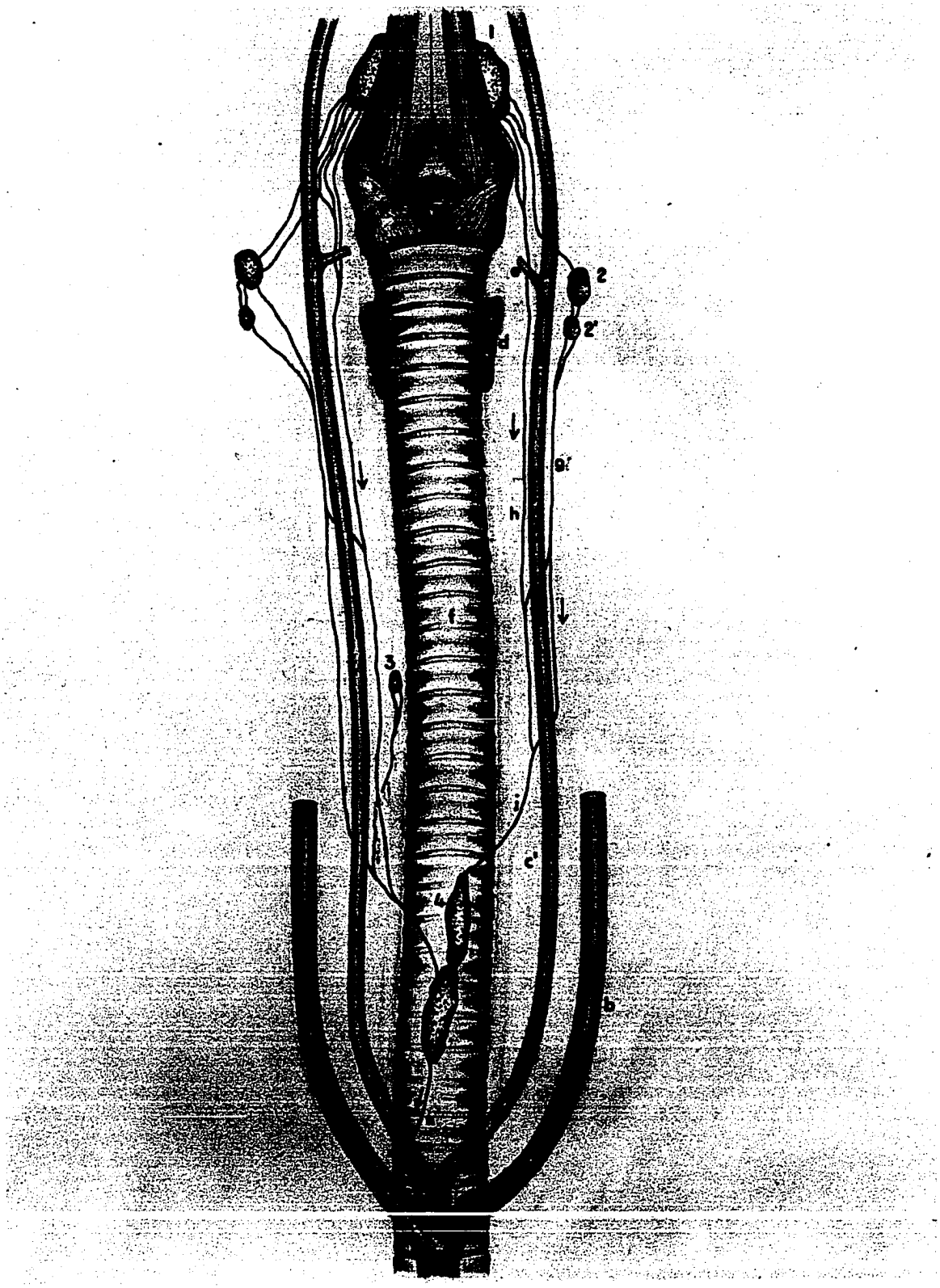
Relation: Lateral: Aponeurosis of cleidooccipitalis muscle and the caudal part of the parotid gland.

Figure 2. Origin, course and termination of the tracheal trunk of the goat. Ventral view

1 Medial retropharyngeal ln.
2,2' Lateral retropharyngeal lnn.
3 Middle deep cervical ln.
4 Caudal deep cervical ln.

A Thyrohyoideus m.
B Thyropharyngeus m.
C Cricothyroideus m.
D Thyroid cartilage

a Bijugular trunk
b External jugular vein
c Bicarotid trunk
c' Common carotid artery
d Thyroid gland
e Cranial thyroid artery
f Trachea
g Lateral radicle of tracheal trunk
h Medial radicle of tracheal trunk
i Efferent of middle deep cervical ln.
j Tracheal trunk
k Efferent of caudal deep cervical ln.


1
2
2'
d
g'
h
3
c'
4
b

Medial: Longus capitis muscle.

Dorsal: The external branch of the accessory nerve.

Ventral: Common carotid artery.

Afferent: From the skin of the parotid region and structures of the cranial part of the neck; efferents of the medial retropharyngeal ln., mandibular ln. and parotid ln.

Efferent: Two to three vessels, arising from the caudal node, converged in forming the lateral radicle of the tracheal trunk (2/g and 3/c).

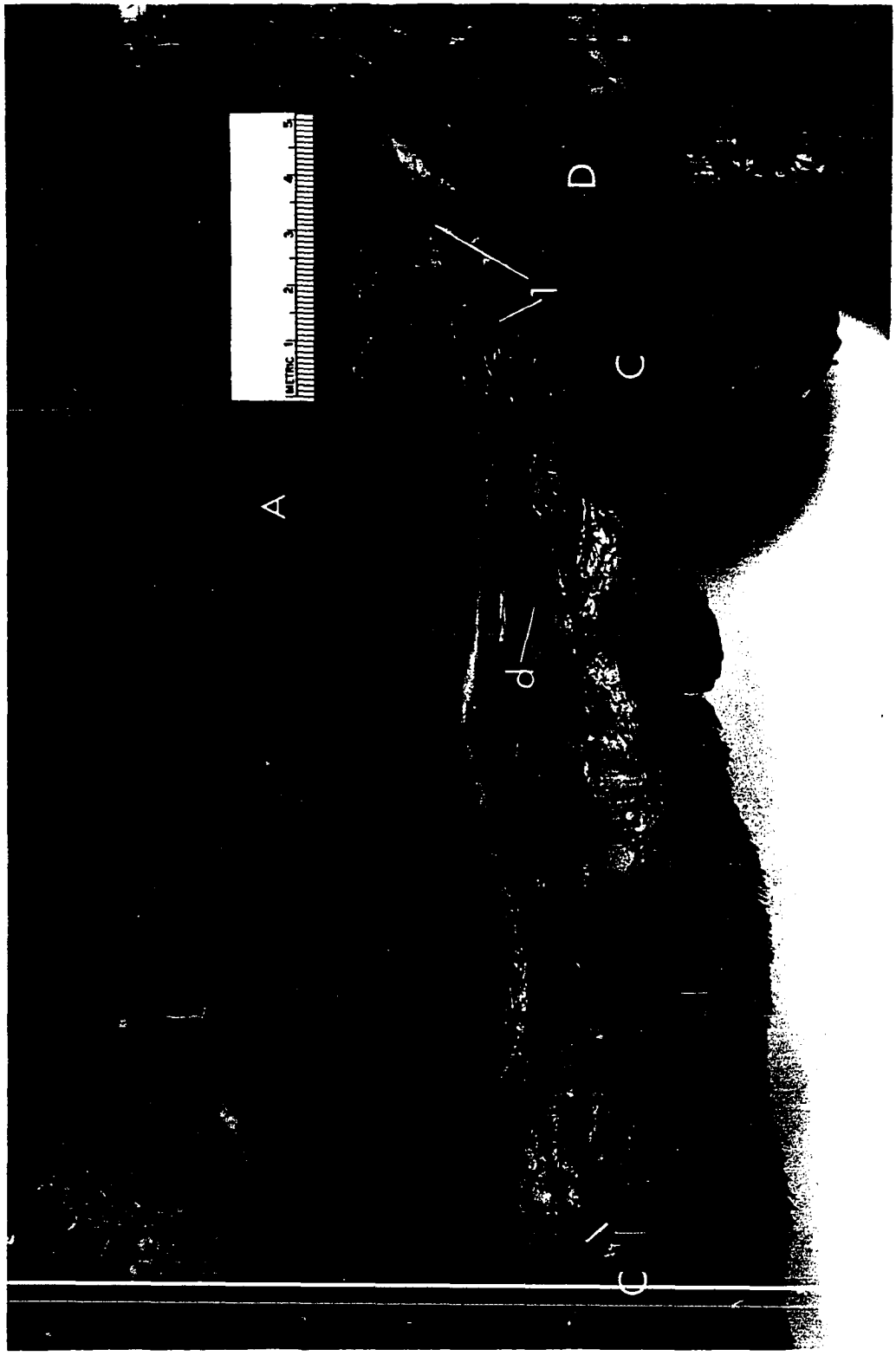
Remarks: The largest node of this group was located approximately at a level of the atlantal fossa, while the second smaller node was situated a few centimeter caudal to the first. The third node, when present, was located cranial to the first, almost reaching the caudal border of the stylohyoid bone. Small hemal lymph nodes were seen in the neighborhood of the lateral retropharyngeal lnn.

Figure 3. Lateral and medial radicles of the tracheal trunk in the goat. Ventrolateral region of the neck. Right side

1 Lateral retropharyngeal lnn.; 2 Caudal deep cervical ln.

A Cleidooccipitalis m.
B Sternomandibularis m. (reflected craniodorsally)
C Sternothyrohyoideus m.
D Parotid gland (distal part)

a Common carotid artery and vagosympathetic trunk (within carotid sheath)
b Trachea
c Lateral radicle
d Medial radicle


A
C
D
l
d

b. Medial retropharyngeal lymph node (4/1 and 7/1)

Location: On the dorsolateral aspect of the pharynx on each side of the midline, about 0.5 cm apart from its fellow of the opposite side.

Number: One on each side of the base of the skull. In one specimen (No. 7) two nodes were observed on the right and four nodes on the left side.

Size: (2.1-4.5) cm long, (1.1-2.6) cm wide, and (0.6-1.2) cm thick.

Shape: More or less triangular with rounded borders, sometimes oval.

Relation: Lateral: Pterygoideus medialis muscle, external carotid and ascending pharyngeal arteries, and glossopharyngeal nerve.

Medial: Medial retropharyngeal ln. of the other side.

Dorsal: Basilar part of the occipital bone and longus capitis muscle.

Ventral: Pterygopharyngeus and thyropharyngeus muscles.

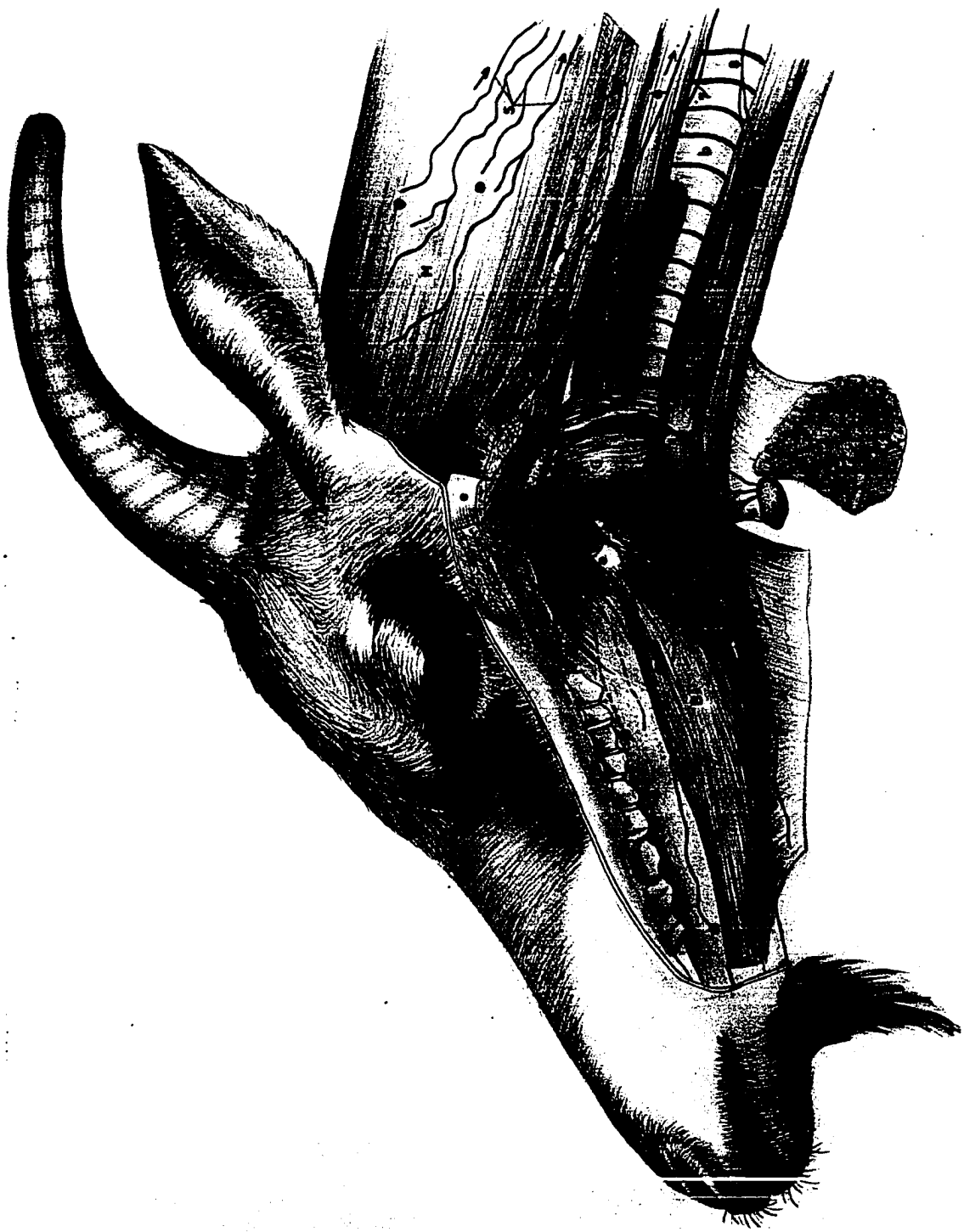
Afferent: From the mouth and nasal cavities,

Figure 4. Deep veew of the lymph nodes and lymph vessels of the head of the goat. The mandible has been removed. ⊗ Injection sites.

1 Medial retropharyngeal ln.; 2 Lateral retropharyngeal lnn.; 3 Cranial deep cervical ln.; 4 Mandibular ln.; 5 Afferent vessels to superficial cervical ln.; 6 Lateral radicle of tracheal trunk; 7 Medial radicle of tracheal trunk; 8 Afferent vessels to superficial cervical ln.

A Mylohyoideus m.
B Styloglossus m.
C Pterygopharyngeus m.
D Pterygoideus medialis m. (cut)
E Occipitohyoideus m.
G Thyropharyngeus m.
H Hyoglossus m.
I Thyrohyoideus m.
J Cricopharyngeus m.
K Sternothyroideus m.
L Sternohyoideus m.
M Cleidooccipitalis m.

a Tongue
b Trachea
c Thyroid gland
d Esophagus
e Stylohyoid bone (major portion removed)
f Ventral part of parotid gland (reflected ventrally)



gum, tongue, muscles of the mandibular region, and efferent of the mandibular ln. in one specimen.

Efferent: Partly to the lateral retropharyngeal lnn., and partly conjugated forming the medial radicle of the tracheal trunk (2/h and 3/d).

Remarks: In specimen No. 7 the nodes on the left side were situated approximately caudal to the other, the most cranial one being the largest. They were interconnected by lymph vessels, and the most caudal node released efferents which formed the medial radicle of the tracheal trunk.

The tracheal trunk There were two radicles of the tracheal trunk (2/j), each arising as efferents of both lateral retropharyngeal lnn. (2/2, 2') and medial retropharyngeal ln. (2/1), respectively, with almost similar relationship on either side of the neck.

The lateral radicle (2/g) of the tracheal trunk, ensuing from the lateral retropharyngeal lnn., passed caudoventrally toward the lateral face of the common carotid artery and descended along the carotid sheath to the caudal

Figure 5. Lateral view of the parotid region of the goat. Right side (close-up)

1 Parotid ln.
2 Mandibular ln.
3 Dorsal buccal branch of facial nerve
4 Lateral retropharyngeal lnn.

A Cleidooccipitalis m.
B Masseter m.
C Skin (reflected dorsally)
D Dorsal part of parotid gland
D' Ventral part of parotid gland

a Afferent vessels of 1
e Efferent vessel of 1 to lateral retropharyngeal lnn.

Figure 6. Ventrolateral view of the mandibular region of the goat

1 Mandibular ln.
2 Trachea
3 External jugular vein

A Sternomandibularis m. (reflected ventrolaterally)
B Sternothyroideus m.
C Cutaneus faciei m.
D Masseter m.
E Rostral belly of digastricus m.

a Afferent vessels of 1
e Efferent vessel of 1 to lateral retropharyngeal lnn. (node not shown)


e


2
e
a
a
c
1

deep cervical ln. (2/4 and 3/2). Frequently this radicle was joined by an efferent (2/i) of the middle deep cervical ln. (2/3). The cranial deep cervical ln., when present, released efferent vessels which joined the lateral radicle.

The medial radicle (2/h and 7/e) of the tracheal trunk, formed mainly by efferents of the medial retropharyngeal ln. (2/1), passed caudally in the prevertebral lamina of the deep cervical fascia, between the trachea and the ventral muscles of the neck, and joined the lateral radicle at the caudal one-third of the neck, thus forming the tracheal trunk (2/j) which entered the caudal deep cervical ln. (2/4).

When two caudal deep cervical lnn. were present, the lateral and medial radicles of the tracheal trunk, after uniting (3/c, d), opened into the corresponding side.

In one specimen there was only one radicle, formed by efferents of the medial retropharyngeal ln. It coursed to the caudal deep cervical ln. along the ventral aspect of the neck, medial to the carotid sheath.

Discussion

Parotid lymph node In the ox (Baum, 1912; Webb, 1944; Sisson and Grossman, 1953; and Brandly et al., 1966) and in the sheep (May, 1970) the parotid ln. was situated partly on the masseter muscle, being partly embedded in the parotid gland. In the goat, however, the latter completely covered

the node and no part of it was situated on the masseter muscle, in agreement with Iwanoff (1947-1948).

Grau (1933) reported that the sheep possessed two to four lymph nodes on each side of the head, while, according to May (1970) in the sheep at times a second node was present. In the goat (9.1 percent of the cases) two nodes were present on each side of the head, thus could be called parotid lnn. The dorsal buccal branch of the facial nerve passes between these two nodes, and this relationship has been reported by Godinho (1968) in 10 percent of the cases. According to him the parotid ln. was not found in two specimens.

The afferent and efferent vessels of the parotid ln. of the goat basically resembled the ox (Baum, 1912) and the sheep (Grau, 1933). In the goat there was no direct connection between lymph vessels of the parotid and mandibular lymph nodes as in the ox.

Mandibular lymph node Contrary to two to four (Grau, 1933) and generally two (May, 1970) mandibular lnn. on either side of the head of the sheep, only one node was found on each side of the head of the goat, in agreement with Iwanoff (1947-1948). Baum (1912) and Montané and Bourdelle (1917) reported one to two nodes on each side of the head of the ox.

In the sheep Grau (1933) stated that the mandibular lnn. received afferent vessels from the parotid region and

the skin of the external nose. These vessels were not seen in the goat dissected in this investigation, however. The efferent vessels of the mandibular ln. in the goat went to the lateral retropharyngeal lnn., thus maintaining the same relationship as in the ox and sheep. In one specimen (No. 3), i.e., 9.1 percent of the cases, an efferent vessel was seen passing to the medial retropharyngeal ln., which apparently has not been reported previously (Iwanoff, 1947-1948).

Lateral retropharyngeal lymph nodes The lateral retropharyngeal lnn. of the goat were basically located at the same site as in the sheep (May, 1970) and ox (Baum, 1912), though no parts of the mandibular gland covered the lymph nodes, as reported in the sheep (May, 1970). The parotid gland was observed extending beyond the lateral retropharyngeal lnn. instead. This difference in relationship with the ox might be attributed to the different position of the occipital bone (perpendicular in the ox), decreasing the distance between the occipital bone and atlas, consequently the mandibular gland extended more caudally.

The afferent vessels of the lateral retropharyngeal lnn. of the goat apparently came from a relatively smaller area than in the ox (Baum, 1912) and the sheep (May, 1970). Their efferent vessels formed the lateral radicle of the

Figure 7. Deep dissection of the head of the goat to expose the medial retropharyngeal ln. The mandible has been removed. Left side

1 Medial retropharyngeal ln.
2 Mandibular ln. (visible as a small violet colored spot, because obscured by adipose tissue)
3 Lateral retropharyngeal lnn.

A Pterygoideus medialis m.
B Caudal part of masseter m.
C Mylohyoideus m.
D Aponeurosis of cleido-occipitalis m.
E Sternocephalicus m.

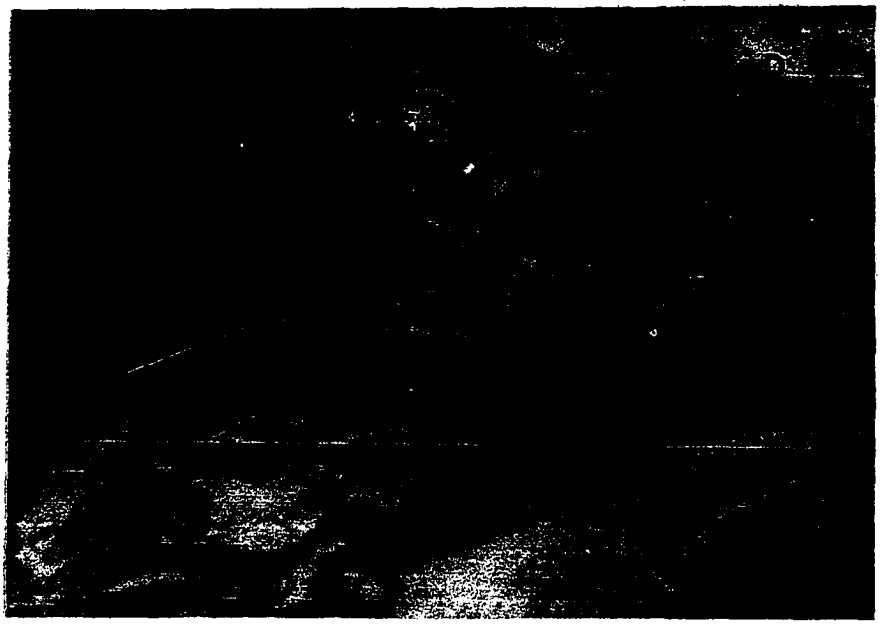
a Common carotid artery
b Vagosympathetic trunk
c Stump of stylohyoid bone
d Lingual vein
e Medial radicle of tracheal trunk arising from 1
e' Efferent of 1 to 3
f Efferent of 2 to 1
g Lateral radicle of tracheal trunk arising from 3
h Efferent from 2 to 3

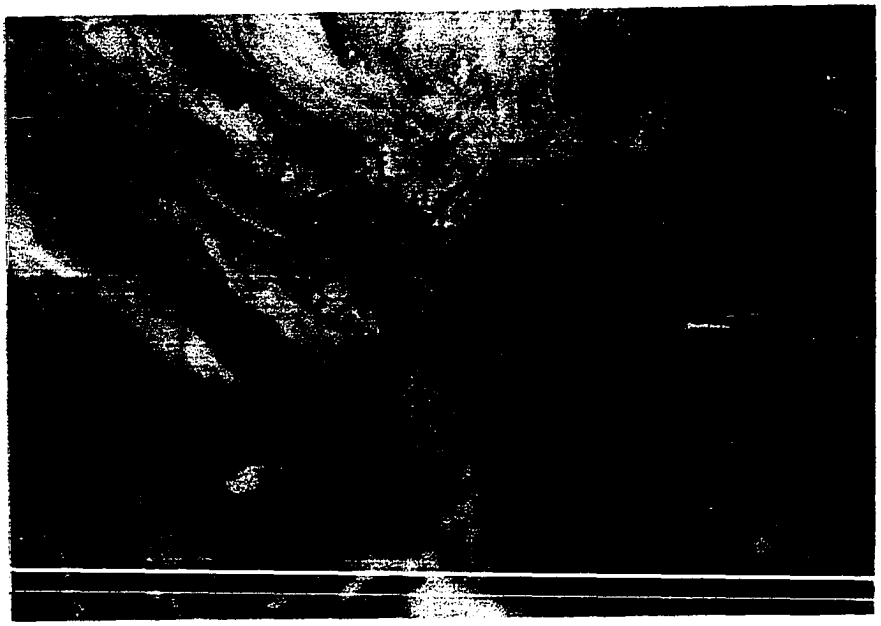
Figure 8. Lateral view of the axillary region of the goat. The thoracic limb has been removed. Left view

1 Costocervical ln.;
2 First rib axillary lnn.

A Sternocephalicus m.
B Subclavius m.
C First rib

a Subclavian artery
b Axillary artery
c Superficial cervical artery
d Axillary vein
e Thoracic duct
f Efferent of superficial cervical ln. (node not shown)
g Efferent of 1





tracheal trunk.

Medial retropharyngeal lymph node The location of the medial retropharyngeal ln. was similar to that of the sheep (May, 1970) and the ox (Baum, 1912).

In the sheep and ox one node (sometimes two) was present on each side of the head. In the goat usually only one node was found on either side of the midline, in agreement with the findings of Iwanoff (1947-1948). In one instance (i.e., 9.1 percent of the cases) two nodes were found on the right side and four on the left, therefore one could speak of medial retropharyngeal lnn.

The afferent vessels of the medial retropharyngeal ln. of the goat basically resembled the other domestic ruminants as available in the literature. In one specimen, however, an efferent vessel of the mandibular ln. of the goat entered the medial retropharyngeal ln. (vide mandibular ln.). The efferents of the medial retropharyngeal ln. partly went to the lateral retropharyngeal lnn. and partly conjugated forming the medial radicle of the tracheal trunk, presenting some species differences.

Pterygoid lymph node This node, present in the ox, (Baum, 1912), was not found in the goat. It was verified by histological sections of tissue taken from the expected site of same in the ox, because of the extension of the dorsal buccal gland in the pterygoid region, which might

obscure the gross examination of the lymph node. Iwanoff (1947-1948) did not find the pterygoid ln. in the goat either.

Hyoid lymph nodes The rostral and caudal hyoid lnn., present in the ox (Baum, 1912), were not found in the goat, concordant with Iwanoff's findings (1947-1948). In the sheep the hyoid lnn. were not present either (May, 1970).

The tracheal trunk The origin, course and relationship of the tracheal trunk of the goat has been illustrated in Figure 2. In the ox (Baum, 1912) and the sheep (May, 1970) the tracheal trunk was formed only by efferent vessels of the lateral retropharyngeal lnn. In the ox it terminated, according to these author's, in the external jugular vein or the thoracic duct on the left side and in the external jugular vein on the right; in the sheep the left tracheal trunk opened into the thoracic duct, while the right one joined the right lymphatic trunk or the thoracic duct.

In the goat the tracheal trunk (2/j) consisted of two radicles, formed by efferents of both lateral and medial retropharyngeal lnn. It opened into the caudal deep cervical ln. and the efferent of the latter (2/k) terminated in the bijugular trunk or the external jugular vein. The trunk did not terminate in the thoracic duct in any specimen. When two caudal deep cervical lnn. were present, the efferents of the lateral and medial retropharyngeal lnn. at

first converged independently forming separate vessels which, in turn, opened in the node of the caudal deep cervical group of the corresponding side of the neck.

In one specimen, i.e., 9.1 percent of the cases, the efferents of the medial retropharyngeal ln. formed the tracheal trunk.

The Lymph Nodes and Lymph Vessels of the Neck

Results

There were two lymphocenters in the neck region of the goat: 1. superficial cervical lc. consisting of the superficial cervical ln.; and 2. deep cervical lc. including the cranial, middle and caudal deep cervical lnn. and the costocervical ln.

The number and average of the lymph nodes in each group and on an individual specimen were presented in Table 6.

1. Superficial cervical lymphocenter

   a. Superficial cervical lymph node (9/2 and 11/1)

      Location: Embedded in fat along the cranial border of the supraspinatus muscle, covered by the cleidooccipitalis, omotransversarius and the cervical part of the trapezius muscles; the ventral border of the node was extended approximately 2.0 cm above the shoulder joint.

Table 6. Number of lymph nodes in each group of the neck of the goat

Group of lymph node(s)		Specimen No. 1	2	3	4	5	6	7	8	9	10	11	Total	Average[a]
Superficial cervical	R[b]	1	1	1	1	1	1	2	1	1	1	1	24	1.09±0.49
	L[b]	1	1	1	1	1	1	2	1	1	1	1		
Cranial deep cervical	R	.	.	.	.	1	1	2	1	.	.	1	9	1.29±0.45
	L	.	.	.	.	.	1	2	.	.	.	.		
Middle deep cervical	R	.	1	.	1	.	.	.	.	1	1	.	8	1.14±0.35
	L	.	1	1	.	2	.	.	.	.	.	.		
Caudal deep cervical	R	.	.	1	.	2	.	2	.	.	.	.	18	1.29±0.59
	L	1	1	1	1	1	1	3	1	1	1	1		
Costocervical	R	.	1	1	.	.	1	1	1	1	1	1	18	1.00±0.00
	L	1	1	1	.	1	1	1	1	1	1	1		
Total of each side	R	1	3	3	2	4	3	7	3	3	3	3		
	L	3	3	4	2	5	3	8	2	2	2	2		
Total of both sides		4	7[c]	7	4	9[c]	7[c]	15	6[c]	6[c]	6[c]	6[c]		7.00±2.86[d]

[a]Mean and standard deviation of lymph nodes on an individual side.

[b]R = right side; L = left side.

[c]Total included the single caudal deep cervical ln.

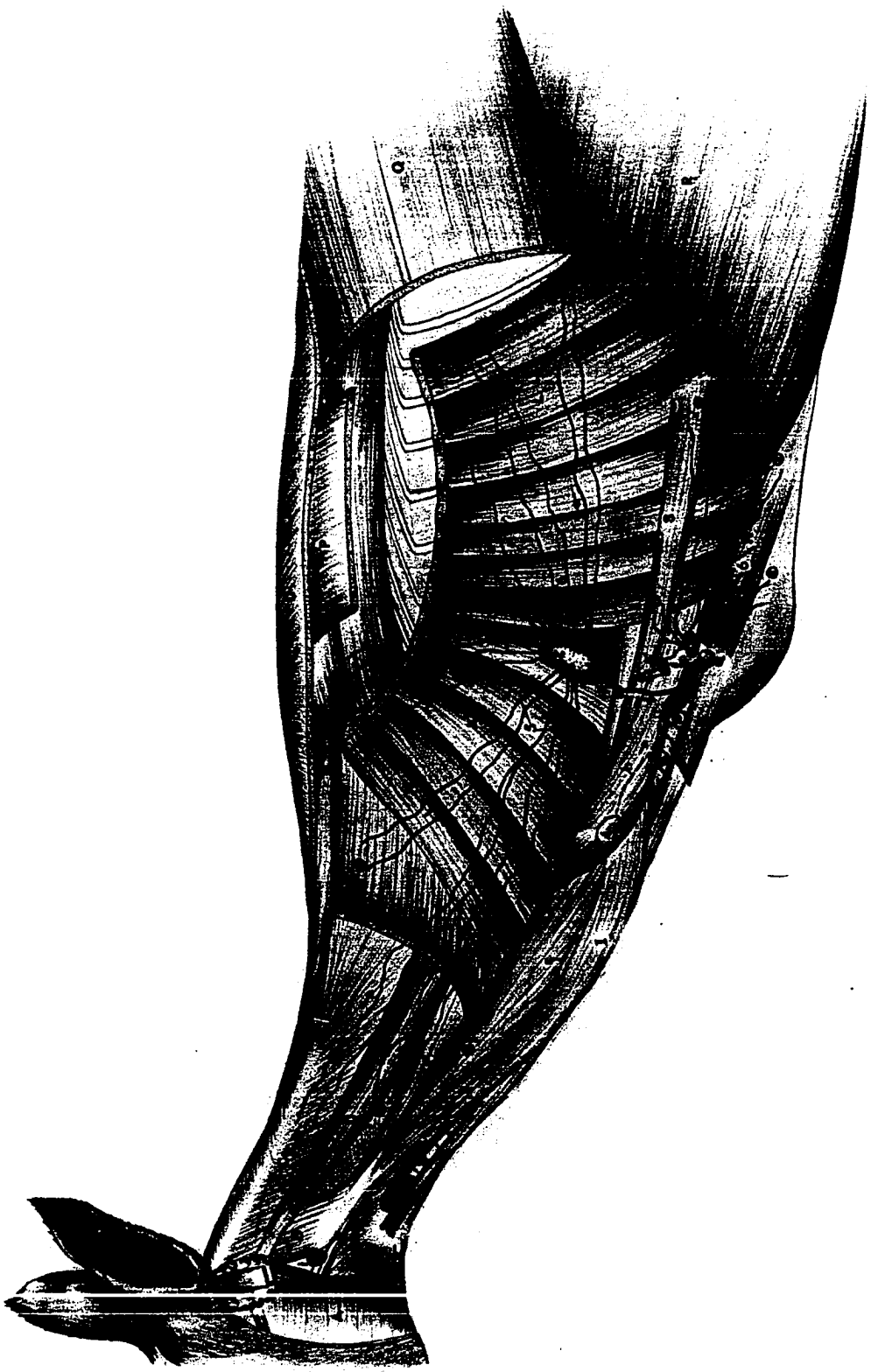
[d]Average number of lymph nodes on an individual specimen.

Figure 9. Deep dissection of the neck and thoracic wall of the goat. Left lateral side. ⊗ Injection sites

1 Lateral retropharyngeal lnn.; 2 Superficial cervical ln.; 3, 3' First rib axillary lnn.; 4 Caudal deep cervical ln.; 5 Afferents from neck region to 2; 6 Afferents from thoracic wall as far as the tenth intercostal space to 2

A Masseter m.
B Obliquus capitis caudalis m.
C Splenius capitis m.
D Longissimus capitis m.
E Sternothyrodeus m.
F Longissimus atlantis m.
G Longus capitis m.
H Splenius m.
I Esophagus
J Sternocephalicus m.
K Serratus ventralis cervicis m.
L Serratus ventralis thoracis m.
M Rectus thoracis m.
N Rhomboideus cervicis m.
O Trapezius m.
P Rhomboideus thoracis m.
R Obliquus externus abdominis m.

a Thyroid gland
b Trachea
c Lateral radicle of tracheal trunk
d Axillary vein
e External jugular vein
f Axillary artery
g Efferent of 2
h Efferent of 4



Number: One on each side of the neck. In specimen No. 7 two nodes were present on either side, one being situated dorsal to the other, connected by rather tough connective tissue.

Size: (3.4-6.0) cm long, (1.5-2.3) cm wide, and (0.8-1.5) cm thick.

Shape: Oval with rounded borders.

Relation: Lateral: Cleidooccipitalis, omotransversarius and cervical part of trapezius muscles.

Medial: Serratus ventralis cervicis muscle.

Caudal: Supraspinatus muscle.

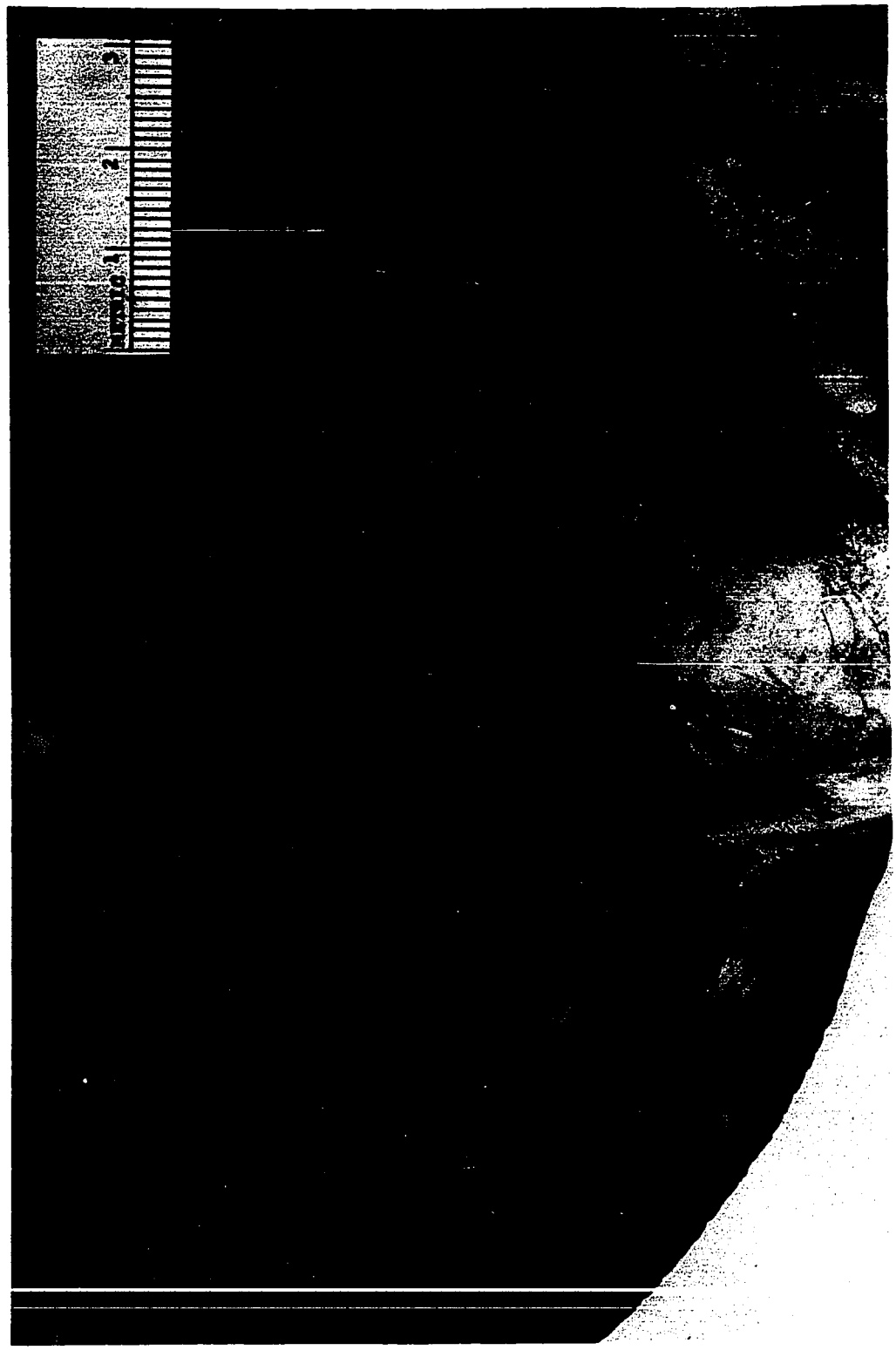
Afferent: From the skin and muscles of the neck (9/5 and 11/3), the caudal dorsal and lateral wall of the thorax, caudally as far as the tenth intercostal space (9/6, 10/a_2 and 11/4), and from the lateral and medial superficial lymph vessels of the thoracic limb (10/a_3 and 11/5, 5').

Efferent: One vessel (8/f and 9/g) opened into the thoracic duct on the left and into the external jugular or

Figure 10. Superficial dissection of the caudoventral part of the neck and distal part of the scapular region, showing the afferent vessels to the superficial cervical ln. The latter was not dissected

A Sternocephalicus m.
B Brachiocephalicus m.
C Trapezius m. (pars cervicis)
C' Trapezius m. (pars thoracis)
D Cutaneus omobrachialis m.
E Skin (reflected dorsally)

a_1 Afferents of superficial cervical ln. from neck region
a_2 Afferents of superficial cervical ln. from cranial thoracic wall
a_3 Afferents of superficial cervical ln. from thoracic limb



brachiocephalic veins on the right. In specimen No. 6 the efferent from the right node opened into the prescapular branch of the superficial cervical vein.

Remarks: Hemal lymph nodes were found in some specimens.

2. Deep cervical lymphocenter

a. Cranial deep cervical lymph node

Location: On a level ventral to the cranial part of the axis vertebra, dorsal to the thyroid gland and at the caudal border of the thyropharyngeus muscle.

Number: Inconstant; one or two nodes either on one or both sides of the neck.

Size: (0.7-1.5) cm long, (0.5-1.0) cm wide, and (0.3-0.4) cm thick.

Relation: Lateral: Sternomastoideus muscle and mandibular gland.

Medial: Thyropharyngeus and cricothyroideus muscles, and trachea.

Afferent: From surrounding structures of the lymph node.

Efferent: When present, they joined the lateral radicle of the tracheal trunk. In specimen

No. 6 the efferents passed to the lateral retropharyngeal lnn.

Remarks: The cranial deep cervical ln. was only found in specimens No. 5, 6, 7, 8 and 11. Hemal lymph nodes were present in the vicinity of the cranial deep cervical ln.

b. Middle deep cervical ln. (2/3)

Location: At the caudal one-third of the lateral face of the trachea; in specimens No. 3, 4, 9 and 10 unilaterally and in specimen No. 2 bilaterally placed.

Number: Inconstant, usually one. In specimens No. 4, 9 and 10 one node was found on the right side, in No. 3 and 5 one on the left, and in No. 2 one node was observed on each side of the trachea.

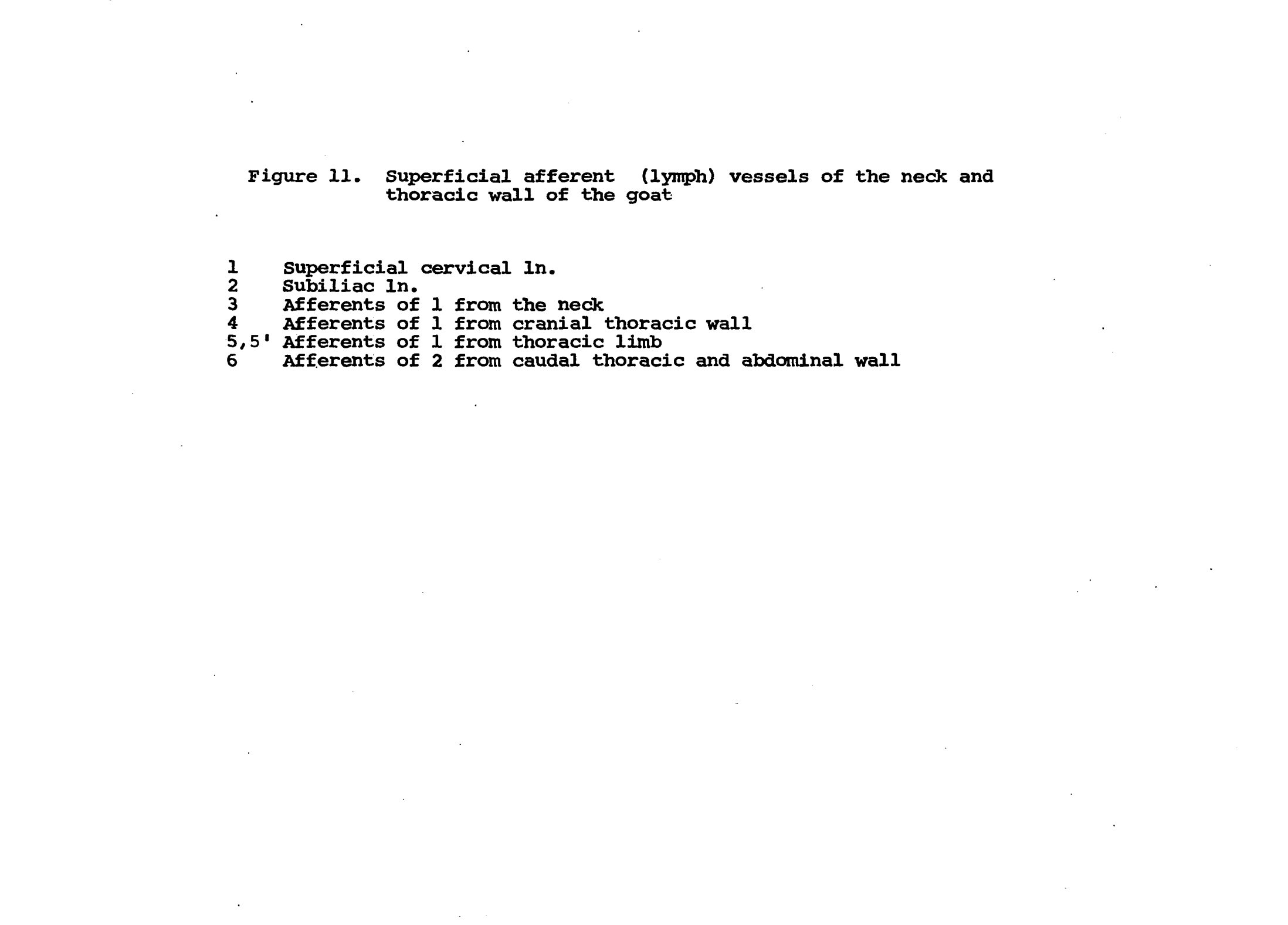
Size: (1.0-1.5) cm long, (0.3-0.6) cm wide, and (0.1-0.15) cm thick.

Relation: Lateral: Sternocephalicus muscle and deep cervical fascia.
Medial: Lateral face of the trachea.

Afferent: From trachea, esophagus and surrounding structures of the lymph nodes.

Efferent: Joined lateral radicle of the

Figure 11. Superficial afferent (lymph) vessels of the neck and thoracic wall of the goat



tracheal trunk (2/i).

Remarks: The middle deep cervical ln. was not present in all specimens.

c. Caudal deep cervical lymph node (2/4 and 12/1,2)

Location: About 4.0-5.0 cm cranial to the cranial thoracic aperture (inlet), along the ventral or on the ventrolateral face of the trachea.

Number: In six specimens (No. 2, 6, 8, 9, 10 and 11) one node was present, approximately on the ventral midline of the neck. In two specimens (No. 1 and 4) one node was found on the left of the latter; in specimen No. 5 two nodes were seen, the larger one lying on the ventrolateral surface of the trachea along the left side of the neck, while the smaller node was situated slightly right to the ventral midline of the neck; in specimen No. 7 two nodes were observed on the right side, the larger one lying on the ventrolateral surface of the trachea, the smaller in the space cranial to the cranial thoracic aperture; on the left side three nodes were seen, the largest lying on the ventrolateral surface

Figure 12. Dissection of the caudal one-third of the neck of the goat. Ventral view

1 Caudal deep cervical ln. (right side)
2 Caudal deep cervical ln. (left side)

A Sternocephalicus m. (reflected caudally)
B Brachiocephalicus m. (ventral border)
C Sternothyroideus m. (reflected caudally)

a Trachea
b External jugular vein
c Thymus (cervical lobe)
d Adipose tissue


B
B
B
2
A
C

of the trachea, the two smaller ones were situated in the space cranial to the cranial thoracic aperture.

Size: (2.8-4.4) cm long, (0.7-0.9) cm wide, and (0.5-0.8) cm thick.

Oval: Oval, elongated.

Relation: Dorsal: Ventral face of trachea (in case of one node).

Ventral: Deep cervical fascia, sternothyrohyoideus and sternocephalicus muscles.

Lateral: Lateral face of the trachea (in case of two nodes).

Afferent: From surrounding muscles of the lymph node, trachea, esophagus, thymus and left and/or right tracheal trunk.

Efferent: Two vessels left the node which, after joining together (4/h) opened either in the external jugular vein or bijugular trunk.

Remarks: In specimen No. 7 the second and smaller node on the right side received afferents from the surrounding structures, and its efferents united in forming a single vessel which opened into the efferent

of the superficial cervical ln. The two other nodes on the left side also received afferents from surrounding structures and their efferents joined the efferent of the large node.

d. Costocervical lymph node (8/1; 15/1 and 16/1)

Location: Medial or closely cranial to the first rib, or between the costocervical artery and vein.

Number: One on each side of the neck. In specimens No. 1 and 5 it was only found on the left side; in specimen No. 4 it was absent.

Size: Lateral: First rib and scalenus medius muscle.

Medial: Trachea and esophagus.

Caudal: Cranial border of the first rib on the left side in specimen No. 7.

Afferent: From muscles in the vicinity of the lymph node, trachea and esophagus.

Efferent: Left side: either joined the thoracic duct or the first rib axillary lnn. Right side: either to cranial mediastinal lnn. or cranial tracheobronchial ln.

Remarks: Small hemal lymph nodes were found in

the vicinity of the node.

Discussion

Superficial cervical lymph node In most cases it was presented by a large single structure of variable size, except in specimen No. 7 where two nodes of approximately equal size were found on both sides of the neck. Grau (1933) and May (1970) reported that in the sheep two superficial cervical lymph nodes might be found, the smaller second node being located dorsal or craniodorsal to the larger first node. The accessory superficial cervical lnn. (nuchal lnn., Baum, 1912), which were present in the ox and in the sheep (Grau, 1933), were not found in the goat in agreement with Iwanoff's investigation (1947-1948). There was no middle superficial cervical ln. in the goat, on the contrary to the sheep (May, 1970). Iwanoff (1947-1948) did not state their occurrence in the goat either.

The afferent vessels of the superficial cervical ln., in general, resembled the ox (Baum, 1912; Henderson, 1946) and the sheep (May, 1970). In all specimens there was only one efferent vessel opening into the external jugular vein or the thoracic duct, but none into the tracheal trunk as in the ox (Baum, 1912; Thornton, 1968; and Koch, 1970), in sheep (May, 1970) and in goat (Iwanoff, 1947-1948). In one specimen (No. 6) the right efferent vessel opened into

the prescapular branch of the superficial cervical vein. This occurrence apparently has not been reported previously in the goat (Iwanoff, 1947-1948), ox (Baum, 1912) as well as in sheep (May, 1970).

Cranial deep cervical lymph node This node was inconstant in the goat. It was present in five specimens (No. 5, 6, 7, 8 and 11), i.e., 45.5 percent of the cases; it was situated either unilaterally or bilaterally. Iwanoff (1947-1948) apparently found the cranial deep cervical lnn. in all specimens investigated. In the ox (Baum, 1912; Sisson and Grossman, 1953 and Dobberstein and Hoffmann, 1964) the number of the cranial deep cervical lnn. varied from four to six and, according to Baum (1912), in some cases might even be absent. May (1970) did not describe the cranial deep cervical ln. in the sheep. The location of the node, when present, agreed with Iwanoff's description (1947-1948) in the goat and Baum's (1912) in the ox.

The afferent vessels of the cranial deep cervical ln. resembled the other domestic ruminants. The efferents, however, joined the lateral tracheal trunk and in one specimen (No. 6) went to the lateral retropharyngeal lnn. In the ox, according to Baum (1912), the efferents of the cranial deep cervical lnn. together with the efferents of the lateral retropharyngeal in some instances formed the accessory tracheal trunk.

Middle deep cervical lymph node This node was also inconstant in the goat, though more frequently found than the cranial deep cervical ln. (in six specimens out of eleven, i.e., 54.6 percent of the cases). It was located unilaterally or bilaterally and in one case (No. 5) two nodes were found on the left side. Iwanoff (1947-1948) stated that the middle deep cervical lnn. were inconstant and were found unilaterally. In the sheep May (1970) found the middle deep cervical lnn. scattered in the midventral region of the trachea and in the ox they consisted of 1-7 nodes (Baum, 1912).

In the ox Dobberstein and Hoffmann (1964) described the afferents of the middle deep cervicals together with the cranial deep cervical lnn., and their efferents joined the caudal deep cervical lnn., and in the absence of the latter they passed directly to the tracheal trunk. The afferents of the middle deep cervical ln. resembled the ox as described by Dobberstein and Hoffmann (1964); its efferent vessel joined the lateral radicle of the tracheal trunk. Further, in the goat there was no evidence about its opening into the caudal deep cervical ln.

Caudal deep cervical lymph node In the ox, according to Baum (1912), the caudal deep cervical lymph nodes numbered two to four, and included a cervicalis caudalis manubrii sterni ln. In one specimen (No. 7) smaller nodes were found cranial

to the cranial thoracic aperture, close to the manubrium sterni, one on the right and two on the left side of the neck; therefore in this case they might be comparable to the cervicalis caudalis manubrii sterni ln. of the ox. In the sheep no description of this lymph node was given by May (1970).

In 72.8 percent of the cases the caudal deep cervical ln. was single, on the contrary to Iwanoff's findings (1947-1948) about its paired occurrence, thus resembling the sheep (May, 1970).

In the ox (Baum, 1912) the caudal deep cervical lnn. received also afferent vessels from the axillary proper and the first rib axillary lymph nodes. Their efferents opened into the right or left tracheal trunk or in the thoracic duct. In the goat no afferents from the axillary proper and the first rib axillary lymph nodes were seen opening into the caudal deep cervical ln. Two efferent vessels arose from the single as well as the paired nodes which then united into one vessel, thus resembling the ox, and opened into the external jugular vein or the bijugular trunk, in contrast to the ox (Baum, 1912).

Costocervical lymph node The location of this node generally agreed with the ox (Baum, 1912) and the sheep (May, 1970). It was also concordant with Iwanoff's description (1947-1948) about its location in the goat.

In two specimens (i.e., 18.2 percent of the cases) the

node was unilateral and in one case (i.e., 9.1 percent of the cases) it was absent.

The afferent vessels of the costocervical ln. was similar to the ox (Baum, 1912; and Koch, 1970). The efferents in the ox might open into the tracheal trunk; in the goat, however, only on the left side they joined the latter, on the right they opened into the cranial mediastinal lnn. or the cranial tracheobronchial ln.

The Lymph Nodes and Lymph Vessels of the Thoracic Limb of the Goat

Results

In the thoracic limb of the goat there was only one lymphocenter, the axillary lc. which included the axillary proper ln. and the first rib axillary lnn.

The number and average of the lymph nodes in each group and on an individual specimen were presented in Table 7.

1. Axillary lymphocenter

   a. Proper axillary lymph node (13/1 and 14/1)

      Location: On the costal surface of the scapula inside the axillary space; about 0.5 cm caudal to the shoulder joint along the distal part of the teres major muscle, in the angle between the subscapular and thoracodorsal vein and on the ventral border of

Table 7. Number of lymph nodes in each group of the thoracic limb of the goat

Group of lymph node(s)		Specimen No. 1	2	3	4	5	6	7	8	9	10	11	Total	Average[a]
Proper axillary	R[b]	1	1	2	1	1	1	1	1	1	1	1	24	1.09±0.28
	L[b]	1	1	1	1	1	1	1	2	1	1	1		
First rib axillary	R	2	1	2	3	2	2	2	2	2	2	2	44	2.10±0.53
	L	2	.	2	2	2	3	3	1	2	2	3		
Total of each side	R	3	2	4	4	3	3	3	3	3	3	3		
	L	3	1	3	3	3	4	4	2	4	3	4		
Total of both sides		6	3	7	7	6	7	7	6	7	6	7	68	6.27±1.14[c]

[a] Mean and standard deviation of lymph nodes on an individual side.

[b] R = right side; L = left side.

[c] Average number of lymph nodes on an individual specimen.

the long thoracic nerve.

Number: Usually one, except in two specimens two nodes on the right (No. 3) and in two nodes on the left (No. 8) limb.

Size: (0.9-2.8) cm long, (0.7-2.0) cm wide, and (0.3-0.5 cm thick.

Shape: Oval, flattened.

Relation: Lateral: Teres major muscle.

Medial: Serratus ventralis thoracis muscle.

Dorsal: Long thoracic nerve.

Ventral: Thoracodorsal vein.

Cranial: Subscapular vein.

Afferent: From structures in the carpal region (13/3), forearm (13/4) and arm (13/5); from the structures on the medial side of the scapula (13/6).

Efferent: To first rib axillary lnn. (13/7 and 14/5).

Remarks: No hemal lymph nodes were observed in the neighborhood.

b. First rib axillary lymph nodes (8/2; 9/3,3'; 13/2 and 14/2)

Location: Lateral aspect of the cranioventral part of the thoracic wall, extending from

Figure 13. Superficial and deep lymph vessels of the thoracic limb of the goat. Medial view

1 Proper axillary ln.
2 First rib axillary lnn.
3 Deep afferents (interrupted lines) from the carpal region to 1
4 Superficial afferents from forearm to 1
5 Superficial afferents from arm to 1
6 Deep efferents (interrupted lines) from the medial side of the scapular region to 1
7 Efferents of 1 to 2
8 Superficial afferents from medial side of digital region and forearm to superficial cervical ln.

A Subscapularis m.
B Supraspinatus m.
C Teres major m.
D Latissimus dorsi m.
E Tensor fasciae antebrachii m.
F Triceps brachii m. (caput longum)
G Triceps brachii m. (caput mediale)
H Coracobrachialis m.
I Biceps brachii m.
J Flexor digitorum profundus m. (caput humerale)
K Brachialis m.
L Extensor carpi radialis m.
M Flexor digitorum superficialis m. (deep belly)
N Flexor carpi ulnaris m.
O Flexor digitorum superficialis m. (superficial belly)
P Tendon of flexor carpi radialis m.

the first rib to the second or second intercostal space; close to the axillary artery and vein and the nerves of the brachial plexus.

Number: Generally, two to three, one large and one or two small, on each side of the thoracic wall. In two specimens (No. 2 and 8), only one node was present on the right side of the former and another on the left side of the latter, respectively.

Size: (0.7-1.5) cm long, (0.5-0.9) cm wide, and (0.3-0.6 cm thick.

Shape: Oval, somewhat flattened or rounded.

Relation: Lateral: Pectoralis profundus and subscapularis muscles.

Medial: First rib or scaleni or rectus thoracis muscles; further axillary artery and vein and nerves of the brachial plexus.

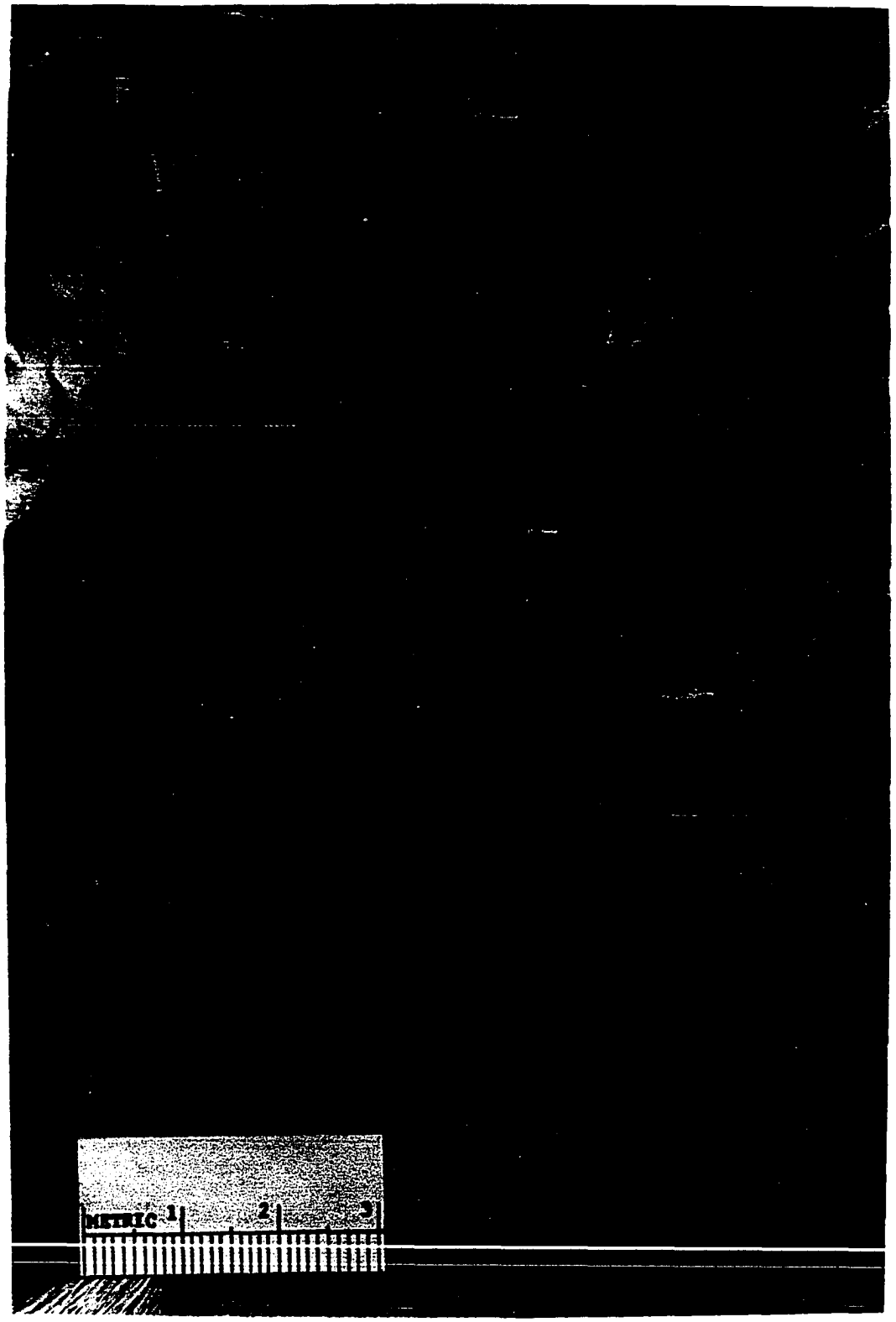
Afferent: From the skin of the ventrolateral part of the thoracic wall, serratus ventralis thoracis, pectoralis profundus, cranial part of obliquus externus abdominis, intercostales externi and interni of the first, second and third intercostal spaces,

Figure 14. Deep dissection of the arm and craniodistal part of the scapula of the goat. Thoracic limb reflected cranially. Medial view (close-up)

1 Proper axillary ln.
2 First rib axillary lnn.
3 Deep afferents from forearm to 1
4 Afferents from cranial part of thoracic wall
5 Efferents from 1 to 2

A Sternocephalicus m.
B Subscapularis m.
C Teres major m.
D Latissimus dorsi m.
E Pectoralis profundus m.
F Scalenus medius m.
PBr Brachial plexus

a Brachial vein
b Axillary vein
c Thoracodorsal vein
d Suprascapular nerve
e Subscapular nerves
f Long thoracic nerve
g Median nerve
h Radial nerve


METRIC 1
2
3

rectus thoracis and the cranial part of the rectus abdominis muscles; efferents of the proper axillary ln.

Efferent: Usually one vessel. On the left side: it joined the thoracic duct or at first received efferents of the costocervical ln. and then joined the thoracic duct or opened directly in the efferent of the superficial cervical ln. On the right side: it joined the efferent of the superficial cervical ln.

Remarks: The relationship of the first rib axillary lnn. to the axillary artery and vein, and the nerves of the brachial plexus was extremely variable. The nodes were interconnected with each other by lymph vessels, and the largest node released the single efferent.

Discussion

Proper axillary lymph node In the goat it usually consisted of one node for each thoracic limb. In two specimens (i.e., 18.2 percent of the cases) two nodes were found on the right (No. 3) and on the left limb (No. 8). Iwanoff (1947-1948) reported that in the goat the proper axillary

lnn. frequently comprised two nodes, a larger and a smaller one. In the ox (Thornton, 1968; Koch, 1970; and Dyce and Wensing, 1971) the proper axillary ln. was a single node. Grau (1933) observed one to two nodes in the sheep.

The location of the proper axillary lymph nodes of the goat in majority of cases resembled the ox (Baum, 1912; Montané and Bourdelle, 1917; Schwarze and Schröder, 1964; and Koch, 1970) and in the sheep (May, 1970).

In the goat the afferent vessels of the proper axillary ln. resembled the sheep (Grau, 1933) and the ox (Baum, 1912). The efferent vessels of the proper axillary ln. in the ox might empty in the caudal deep cervical lnn. (Baum, 1912).

First rib axillary lymph nodes In the goat they numbered 2-3, in accord with Iwanoff's findings (1947-1948), similar to the ox (Koch, 1970) and the sheep (Grau, 1933). In two specimens (i.e., 18.2 percent of the cases) only one node was found unilaterally. In the ox the number of the first rib axillary lnn. varied 1-3 in most cases, though 2-3 nodes were frequently present (Baum, 1912). The latter was also confirmed by Koch (1970). In the sheep 2-3 nodes were present (Grau, 1933).

The afferent vessels of the first rib axillary lymph nodes of the goat came mostly from the ventral thoracic and cranial abdominal walls. In the ox Koch (1970) described the afferents coming from the thoracic limb as far distal to the

carpal joint. Iwanoff (1947-1948) stated that the afferents also came from the forelimb of the goat. The above observations could not be substantiated in the present investigation on the goat, similar to the sheep (Grau, 1933). In the ox the efferents joined the tracheal trunk or the caudal deep cervical lnn. (Martin, 1919). The efferent vessel of the goat, however, joined the thoracic duct (on the left) or the efferent of the superficial cervical ln. (on the right). Iwanoff (1947-1948), on the contrary, found the efferents of the first rib axillary lnn. joining the tracheal trunk as in the ox.

The cubital ln. was not found in the goat, concordant with the ox (Baum, 1912). In the sheep Grau (1934) stated that only in 2 out of 35-40 cases this node was present.

The Lymph Nodes and Lymph Vessels of the Thoracic Wall and Viscera of the Thoracic Cavity of the Goat

Results

There were four lymphocenters in the thoracic wall and the thoracic cavity of the goat: 1. the dorsal thoracic lc. consisting of the intercostal and aortic thoracic lnn.; 2. the ventral thoracic lc. comprising the sternal ln.; 3. the mediastinal lc. consisting of the cranial, middle and caudal mediastinal lnn.; and 4. the bronchial lc., consisting of the cranial, middle, right and left tracheobronchial lnn., the pulmonary lnn., and the pericardiac ln.

The number and average of the lymph nodes in each group, and on an individual specimen were presented in Table 8.

1. Dorsal thoracic lymphocenter

a. Intercostal lymph nodes (15/3 and 16/3)

Location: Embedded in fat at the dorsal end of several intercostal spaces, somewhat dorsal to the thoracic sympathetic trunk being covered by the costal pleura.

Number: Five to six nodes on each side of the inner thoracic wall.

Size: (0.3-0.6) cm in diameter.

Shape: Oval or round.

Relation: Lateral: Dorsal part of the intercostalis internus muscle.

Medial: Costal pleura and endothoracic fascia.

Ventral: Thoracic sympathetic trunk.

Afferent: From muscles of the dorsal and lateral wall of the thorax.

Efferent: To aortic thoracic or cranial mediastinal lnn.

Remarks: The intercostal lnn. were not found in each intercostal space. In two specimens (No. 4 and 7) the cranial most intercostal ln. was located on a level of the second

Table 8. Number of lymph nodes in each group on the thoracic wall and thoracic cavity of the goat

Group of lymph node(s)		Specimen No.											Total	Average[a]
		1	2	3	4	5	6	7	8	9	10	11		
Intercostal	R[b]	5	6	6	6	6	6	7	5	6	6	6	128	5.82±0.57
	L[b]	6	6	5	7	5	6	5	6	6	5	6		
Aortic thoracic	R	6	6	6	6	5	5	6	6	6	6	6	127	5.77±0.51
	L	6	5	7	6	6	5	6	5	6	5	6		
Sternal	R	1	1	1	1	1	1	2	1	1	1	1	23	1.05±0.21
	L	1	1	1	1	1	1	1	1	1	1	1		
Cranial mediastinal	R	3	1	2	2	1	2	3	2	2	3	2	42	1.05±0.21
	L	2	2	1	1	2	3	1	1	2	2	2		
Total of each side	R	15	14	15	15	13	14	18	14	15	16	15		
	L	14	14	14	15	14	15	13	13	15	13	15		
Total on both sides		30	28	29	30	27	29	31	27	30	29	30	315	29.09±1.24[c]

[a]Mean and standard deviation of lymph nodes on an individual side.

[b]R = right side; L = left side.

[c]Average number of lymph nodes on an individual.

Table 8 (Continued)

Group of lymph node(s)		Specimen No. 1	2	3	4	5	6	7	8	9	10	11	Total	Average[a]
Middle mediastinal	R[b]	1	2	3	2	2	2	1	2	2	2	2	37	1.77±0.60
	L[b]	2	1	1	1	2	2	3	2	2	1	1		
Caudal mediastinal	R													
	L	1	1	1	1	1	1	1	1	1	1	1	11	1.00±0.00
Cranial tracheo-bronchial	R	1	1	1	1	1	1	1	1	1	1	1	11	1.00±0.00
	L	.	.	.	.	.	.	.	.	.	.	.		
Right tracheo-bronchial	R	.	1	.	.	.	.	1	.	.	.	.	2	1.00±0.00
	L	.	.	.	.	.	.	.	.	.	.	.		
Total on each side	R	2	4	4	3	3	3	3	3	3	3	3		
	L	2	1	1	1	2	2	3	2	2	1	1		
Total on both sides[d]		5	6	6	5	6	6	7	6	6	5	5	61	5.72±0.62[c]

[d]Total included the single caudal mediastinal ln.

Table 8 (Continued)

Group of lymph node(s)		Specimen No. 1	2	3	4	5	6	7	8	9	10	11	Total	Average[a]
Middle tracheo-bronchial	R[b]	.	.	1	.	1	.	.	1	.	.	.	3	1.00±0.00
	L[b]	.	.		.		.	.						
Left tracheo-bronchial	R	.	.	.	.	.	.	.	.	.	.	.	11	1.00±0.00
	L	1	1	1	1	1	1	1	1	1	1	1		
Pulmonary	R	.	.	.	.	.	.	.	.	.	1	.	2	1.00±0.00
	L	.	.	.	.	.	.	.	.	.	1	.		
Pericardial	R	.	.	.	.	.	.	.	.	.	.	.	4	1.00±0.00
	L	.	1	.	1	.	.	.	.	1	1	.		
Total on each side	R	.	.	.	.	.	.	.	1	2	3	1	20	
	L	1	2	1	2	1	1	1	1	2	3	1		
Total on both sides		1	2	2	2	2	1	1	2	2	4	1	20	1.82-0.83[c]

(specimen No. 4) or the third intercostal space (specimen No. 7).

b. Aortic thoracic lymph nodes (15/4 and 16/4)

Location: Embedded in fat dorsal to the thoracic aorta, somewhat ventral to the bodies of the thoracic vertebrae.

Number: Five to six nodes on each side of the thoracic cavity. In one specimen (No. 3) there were seven lymph nodes on the left side.

Size: (0.4-1.5) cm long, (0.3-0.6) cm wide, and (0.2-0.5) cm thick.

Shape: Oval with slightly rounded borders.

Relation: Dorsal: Bodies of the thoracic vertebrae and the thoracic sympathetic trunk.

Ventral: Thoracic aorta and the thoracic duct.

Afferent: From the esophagus and intercostales interni and externi muscles, and efferents of the intercostal lnn.

Efferent: To the cranial or middle mediastinal lnn.

Remarks: The location of the aortic thoracic lnn. with regard to the ribs and intercostal spaces varied considerably.

However, the most cranially located node was situated on a level of the fifth intercostal space.

2. Ventral thoracic lymphocenter

a. Sternal lymph node (15/8; 16/9 and 17/2,2')

Location: Embedded in fat at the cranial border of the transversus thoracis muscle on a level of the first intercostal space.

Number: One node on each side of the median plane, except in specimen No. 7 having two nodes on the right side (17/2,2').

Size: (0.6-1.8) cm long, (0.4-1.1) cm wide, and (0.2-0.8) cm thick.

Relation: Ventral: Ventral part of the intercostalis internus muscle.

Dorsal: Costal pleura.

Caudal: Cranial border of transversus thoracis muscle.

Afferent: From the transversus thoracis, distal part of the intercostales interni and externi, obliquus externus abdominis, pectoralis profundus and rectus abdominis muscles.

Efferent: Right side: Joined the efferent of the caudal deep cervical ln.

Left side: Joined the efferent of the superficial cervical ln.

Remarks: The second sternal ln. of specimen No. 7 was located on a level of the second intercostal space.

3. Mediastinal lymphocenter

a. Cranial mediastinal lymph nodes (15/2 and 16/2)

Location: In the cranial mediastinum, dorsal to the brachiocephalic trunk and the cranial vena cava. Embedded in fat between the longus colli muscle and the trachea; the nodes were located on the trachea, or the esophagus, or the longus colli muscle.

Number: Two to three nodes on each side of the thoracic cavity. In specimens No. 2 and 5 only one node was present on the right side, while in specimens No. 3, 4, 7 and 8 only one node was seen on the left.

Size: (0.8-1.1) cm long, (0.3-0.7) cm wide, and (0.1-0.4) cm thick.

Relation: Medial: Esophagus or trachea.
Dorsal: Longus colli muscle.

Afferent: Esophagus, trachea, thymus, longus colli muscle, and efferents of the

intercostal, aortic thoracic and cranial tracheobronchial lnn.

Efferent: Joined the costocervical ln. or its efferents.

Remarks: Hemal lymph nodes of various sizes (pin-head size to 0.2 cm) were found in the surroundings of the cranial mediastinal lnn.

b. Middle mediastinal lymph nodes (15/5; 16/5 and 20/2)

Location: In the middle mediastinum, dorsal to the base of the heart; were embedded in adipose tissue found between the esophagus and longus colli muscle on a level extending from the third-fifth rib.

Number: One to two nodes on each side of the thoracic cavity.

Size: (0.7-3.0) cm long, (0.5-1.0) cm wide, and (0.3-0.5) cm thick.

Relation: Dorsal: Longus colli muscle.
Ventral: Esophagus.
Medial: Aortic arch and thoracic aorta.

Afferent: From the esophagus, trachea, longus colli muscle, lungs, mediastinum and the

efferents of the aortic thoracic and caudal mediastinal lnn.

Efferent: Joined the cranial mediastinal lnn.

Remarks: Hemal lymph nodes were present in the surroundings of the middle mediastinal lnn.

c. Caudal mediastinal lymph node (15/6 and 16/6)

Location: In the caudal mediastinum, between thoracic aorta and esophagus, extending from the sixth-ninth intercostal spaces.

Number: One node (unpaired).

Size: (10.0-13.0) cm long, (0.8-1.8) cm wide, and (0.4-0.7) cm thick.

Shape: Elongated, fusiform with a wide dorsal surface.

Relation: Dorsal: Thoracic aorta.
Ventral: Esophagus.

Afferent: From the diaphragm, trachea, esophagus, mediastinum, pericardium, epaxial muscles on the dorsal part of the thoracic wall extending from the sixth-twelfth intercostal spaces.

Efferent: One vessel, joining the middle mediastinal lnn.

Remarks: The cranial part of the single caudal mediastinal ln. might be split for about 0.5 cm. Hemal lymph nodes were present in its surroundings.

4. Bronchial lymphocenter

a. Cranial tracheobronchial lymph node (15/7; 18/1 and 22/1)

Location: Only present on the right side of the thoracic cavity, lying in most specimens between the base of the heart and trachea; extended caudally from the tracheal bronchus to the bifurcation of the trachea or twisted ventrolaterally between the right azygos vein and the tracheal bronchus. In one specimen the node extended toward the left about 1.0 cm beyond the bifurcation of the trachea.

Number: One node.

Size: (2.1-7.0) cm long, (0.5-1.3) cm wide, and (0.3-0.8) cm thick.

Shape: Elongated, flattened.

Relation: Dorsal: Trachea.
Ventral: Base of the heart.
Lateral: Right azygos vein and tracheal bronchus.

Afferent: From the cranial lobe of the right lung, trachea, esophagus, pericardium and the efferent of the right tracheobronchial ln., when present.

Efferent: Joined the cranial mediastinal lnn.

Remarks: Hemal lymph nodes were present in the neighborhood of the cranial tracheobronchial ln.

b. Right tracheobronchial lymph node (22/3)

Location: On the dorsolateral surface of the tracheal bifurcation.

Number: Inconstant; only one node; present only in two specimens (No. 2 and 7).

Size: 0.2 cm in diameter.

Shape: Rounded.

Relation: Medial: Tracheal bifurcation.
Lateral: Medial face of the middle lobe of the right lung.

Afferent: From the middle lobe of the right lung and heart.

Efferent: Joined the cranial tracheobronchial ln.

Remarks: Small hemal lymph nodes were present in the neighborhood of the right tracheobronchial ln.

c. Middle tracheobronchial lymph node (19/1 and 22/4)

Location: On the dorsal surface of the tracheal bifurcation. In one specimen (No. 3) it was located a few centimeter caudal to the preceding lymph node on the left bronchus (19/1).

Number: Inconstant. Only in two specimens (No. 2 and 7) the node was present.

Size: 0.3 cm in diameter.

Shape: Rounded.

Relation: Ventral: Tracheal bifurcation.
Dorsal: Caudal lobes of the lungs.

Afferent: From the accessory and caudal lobes of the lungs and the efferents of the pulmonary ln.

Efferent: Joined the left tracheobronchial ln.

Remarks: Hemal lymph nodes were found in the neighborhood of the middle tracheobronchial ln.

d. Left tracheobronchial lymph node (21/1, 22/2 and 23/4)

Location: On the left face of the tracheal bifurcation, caudal to the ligamentum arteriosum and the aortic arch, and between the bifurcation of the trachea and the

pulmonary trunk.

Number: Only one node present in all specimens.

Size: (2.1-3.5) cm long, (0.1-1.0) cm wide, and (0.4-0.6) cm thick.

Shape: Triangular in most specimens; elongated in one specimen (No. 3).

Relation: Cranial: Aortic arch and left recurrent laryngeal nerve.

Caudal: Right azygos vein.

Lateral: Pulmonary trunk and aortic arch.

Medial: Left main bronchus.

Afferent: From the caudal lobe of the left lung, trachea, esophagus, mediastinum, heart and the efferent of the middle tracheobronchial ln.

e. Pulmonary lymph node (22/5,5)

Location: On the left and right main bronchus, being covered by lung tissue for abour 2.5 cm.

Number: Inconstant; one node on each side. Present only in one specimen (No. 10).

Size: (0.7-1.0) cm long, (0.4-0.6) cm wide, and (0.2-0.5) cm thick.

Shape: Oval with rounded borders.

Relation: Ventrally to dorsal face of the main

bronchus, and surrounded by lung tissue.

f. Left pericardial lymph node (16/8 and 20/1)

Location: On the base of the pericardium, near the site of penetration of the left azygos vein through the pericardium and into the cranial vena cava.

Number: Inconstant; only one node found in four specimens (No. 2, 4, 9 and 10).

Size: (1.2-1.5) cm long, (0.5-1.0) cm wide, and (0.3-0.5) cm thick.

Shape: Oval, flattened.

Relation: Dorsal: Dorsal vagal trunk.
Ventral: Phrenic nerve.
Lateral: Pericardial pleura.
Medial: Pericardium.

Afferent: From the pericardium.

Efferent: Joined the cranial mediastinal lnn.

Remarks: No hemal lymph nodes were present in the neighborhood of the left pericardial ln.

The thoracic duct (15/j; 16/j and 20/c) The thoracic duct of the goat, after entering the thoracic cavity through the aortic hiatus of the diaphragm, ran cranially along the right face of the thoracic aorta. At the level of the fourth intercostal space it turned obliquely toward the left surface

of the esophagus, then passed cranially beyond the cranial thoracic aperture or inlet for about 2.0-3.0 cm and opened either into the external jugular vein or into the bijugular trunk.

Discussion

The external or lateral thoracic wall of the goat (11, 25, 26 and 27) In the ox the lymph of the thoracic and abdominal wall was drained by two lymph nodes, i.e., the superficial cervical and subiliac lnn. (Baum, 1912). The afferent vessels originating cranial to a line drawn from the olecranon to the dorsal end of the tenth-twelfth rib coursed to the former lymph node. The subiliac ln. received afferents arising from area caudal to the above line.

In the goat the border line ran from the olecranon to the dorsal end of the tenth-eleventh rib and the afferents arising cranial to this line went to the superficial cervical ln. (11/4), and caudal to it to the subiliac ln. (11/6).

In the sheep the border line, however, was the seventh thoracic vertebra (Grau, 1933).

Intercostal lymph nodes Not all intercostal spaces of the goat contained the intercostal lnn., similar to the ox (Baum, 1912; Thornton, 1968; and Koch, 1970) and in the goat (Iwanoff, 1947-1948). In the sheep they were seldom observed (Godbille, 1915). Grau (1933) described the

intercostal lnn. of the sheep as in the ox, though May (1970) stated that each intercostal space of the sheep contained an intercostal ln. Some intercostal lnn. of the sheep were located more laterally on a level with the angle of the rib (Grau, 1934). This location of the intercostal lnn., however, was not seen in the goat.

The afferent vessels of the intercostal lnn. in the goat for a greater part resembled the ox (Somers, 1951 and Stokoe, 1967), though no afferents were seen arising from the peritoneum (Stokoe, 1967). The efferent vessels in the goat joined partly the cranial mediastinal lnn., and partly the aortic thoracic lnn., in accord with Iwanoff (1947-1948); in addition, the latter author stated that they might open directly into the thoracic duct, which could not be confirmed in this study.

Aortic thoracic lymph nodes In the ox these nodes numbered four to five (Dobberstein and Hoffmann, 1964). No number was given for the aortic thoracic lnn. in the sheep (May, 1970). In the goat there were five to six nodes on each side of the thoracic cavity, except one specimen (No. 3) having seven nodes on the left side. Iwanoff (1947-1948) reported five to seven aortic thoracic lnn. in the goat.

The location of the aortic thoracic lnn. of the goat resembled the ox (Dobberstein and Hoffmann, 1964) and the sheep (May, 1970).

The afferent vessels of the aortic thoracic lnn. in the goat came from structures surrounding the nodes, thus resembling the ox (Dobberstein and Hoffmann, 1964); however, no afferents were observed coming from the liver in the goat. In the ox the efferent vessels joined the thoracic duct and sometimes the mediastinal lnn. (Dobberstein and Hoffmann, 1964). The efferents of the goat joined the middle or the cranial mediastinal lnn. and no afferents were seen joining the thoracic duct.

Sternal ln. In the goat this node was situated one on each side of the midline of the sternum. They were located cranial to the cranial border of the transversus thoracis muscle. In one specimen (No. 7) a second node was present on a level with the second costal cartilage, close to the sternum. In the ox the sternal lnn. were represented by a group of lymph nodes in the intercostal spaces (Baum, 1912), thus more nodes were present in the ox than in the goat. In the sheep one to three nodes were present; one of them, the cranial sternal ln., was situated in the intercostal space (Grau, 1933).

The afferent vessels of the sternal ln. of the goat essentially agreed with the ox (Thornton, 1968), though Iwanoff (1947-1948) stated that the sternal ln. received efferents of the ventral mediastinal lnn. This occurrence, however, could not be confirmed in the specimen investigated.

In the ox the efferent vessels joined the caudal deep cervical lnn. or the tracheal trunk on the right side or the thoracic duct on the left (Somers, 1951). In the goat the efferents united with that of the caudal deep cervical ln. on the right and with the efferent of the superficial cervical ln. on the left. Iwanoff (1947-1948) stated that the efferents of the sternal ln. passed to the thoracic duct on the left side (i.e., resembling the ox) and to the cranial nodes of the cranial mediastinal lnn. on the right.

Cranial mediastinal lymph nodes In the goat there were two to three mediastinal lnn. on each side of the thoracic cavity. Iwanoff (1947-1948) stated that on the left side there were two to three nodes and five to six on the right. In the ox Baum (1912) reported four to eleven nodes on the left and three to six on the right.

The afferent vessels of the cranial mediastinal lnn. in the goat for a greater part resembled the ox, though in the goat the afferents from the lungs, heart and pericardium were not seen as in the ox (Dobberstein and Hoffmann, 1964). The efferent vessels of the goat differed from the ox (Dobberstein and Hoffmann, 1964), i.e., in the goat they joined the efferent of the costocervical ln., while in the ox the efferents opened into the thoracic duct or tracheal trunk.

Middle mediastinal lymph nodes These nodes were found on both sides of the thoracic cavity of the goat, in contrast to the ox (Koch, 1970) and in the goat (Iwanoff, 1947-1948). Both authors stated that the middle mediastinal lnn., in the respective species, were located on the right face of the esophagus and the right side of the aortic arch, therefore, only on the right side of the thoracic cavity. In the specimen presently investigated the nodes were situated on the esophagus, the aortic arch and on the origin of the thoracic aorta.

The afferent vessels of these nodes in the goat for a greater part resembled the ox (Baum, 1912), except for the efferents of the first-fourth intercostal lnn. and the right tracheobronchial ln. were not seen opening to these lymph nodes in the goat. The efferent vessels of the right and left middle mediastinal lnn. joined the cranial mediastinal lnn. of the corresponding side.

Caudal mediastinal lymph node In the ox the caudal mediastinal lymph nodes consisted of a large node and two to three (or one to four) smaller nodes (Baum, 1912), though Thornton (1968) reported eight to twelve nodes. The caudal mediastinal lnn. of the sheep comprised two nodes (May, 1970). In the goat there was only a single large node, situated in the caudal mediastinum almost about the median plane, in agreement with Iwanoff (1947-1948). The latter

author stated that the caudal mediastinal lnn. were fused together into a single node.

The afferent vessels of the caudal mediastinal ln. in the goat partly agreed with the ox (Koch, 1970), though in the former no afferents were seen coming from the peritoneum, liver, spleen and the efferents of the middle mediastinal and pulmonary lnn. were seen joining the caudal mediastinal ln. In the goat the efferent vessel of the caudal mediastinal ln. joined the middle mediastinal lnn., as opposed to the thoracic duct (Baum, 1912), while in the sheep they joined the thoracic duct or the cranial mediastinal lnn.

Cranial tracheobronchial lymph node Contrary to Iwanoff's description (1947-1948) in the goat, the cranial tracheobronchial ln. (in specimens investigated) was large regardless of the age of the animal.

The location of the node partly agreed with Iwanoff (1947-1948), i.e., in his case of a four months old goat. In the ox the cranial tracheobronchial ln. was situated on the right face of the trachea, partly cranial and ventromedial to the origin of the tracheal bronchus, between the latter and the right azygos vein, so that the vein partly covered the right surface of the node (Baum, 1912). In the goat the right azygos vein covered only a small portion of the large cranial tracheobronchial ln.

In the ox the afferents of the cranial tracheobronchial

ln. came from the lungs and the efferents of the pulmonary lnn. (Baum, 1912). In the goat the afferent vessels were seen coming from the pericardium, trachea, esophagus and the efferents of the right tracheobronchial ln., when present. The efferent vessels in the goat resembled the ox (Baum, 1912), i.e., they joined the cranial mediastinal lnn.

Right tracheobronchial lymph node This node was inconstant in the goat and was only found in two specimens, i.e., 18.2 percent of the cases. Iwanoff (1947-1948) reported two nodes in the goat, however, fused together to form a small node. In the ox (i.e., in about 75 percent of the cases) the right tracheobronchial ln. was present (Baum, 1912). The efferent vessels of the right tracheobronchial ln. in the ox came from the lungs, thoracic part of the esophagus and the heart (Somers, 1951). In the goat it only received the afferents from the middle lobe of the right lung. The efferents in the goat joined the cranial tracheobronchial ln., while in the ox they opened into the mediastinal lnn. (Somers, 1951).

Middle tracheobronchial lymph node This node was found more frequently in the ox, i.e., 50 percent of the cases (Baum, 1912). In the goat the node was present in three specimens, i.e., 27.3 percent of the cases. Iwanoff (1947-1948) reported that the middle tracheobronchial

ln. sometimes consisted of two nodes.

The afferent vessels of the middle tracheobronchial ln. of the ox came from the right and left caudal lobes of the lungs (Baum, 1912). In the goat the afferents for a greater part resembled the ox, though in the goat the afferent vessels were seen coming from the pulmonary ln. The efferents of the goat joined the left tracheobronchial ln., while in the ox they opened into the right tracheobronchial ln. (Baum, 1912).

Left tracheobronchial lymph node The location of the left tracheobronchial ln. in the goat resembled the ox (Baum, 1912) and in accord with Iwanoff's description (1947-1948) of the goat. Baum (1912) reported two nodes in one case of the ox, with a third node between them. In all specimens investigated no other nodes were found in the goat.

The left tracheobronchial ln. of the ox (Baum, 1912) received the afferent vessels from the thoracic part of the esophagus, and sometimes the efferents of the middle tracheobronchial, aortic thoracic and left pericardial lnn. In the goat the afferents of the left tracheobronchial ln. came also from the heart, caudal lobe of the left lung and mediastinum; however, no efferents of the middle tracheobronchial, aortic thoracic and left pericardial lnn. were seen joining the left tracheobronchial ln. The efferent vessels of the left tracheobronchial ln. in the goat joined the cranial

mediastinal lnn., while in the ox their efferents coursed to the common efferent of the caudal aortic mediastinal ln. (Baum, 1912).

Pulmonary lymph node In the goat this lymph node was found only in one specimen (No. 10), i.e., only in 9.1 percent of the cases. It was located on the main bronchus, covered by lung tissue. The pulmonary lnn. were also inconstant in the ox (Baum, 1912; Stokoe, 1967; and Thornton, 1968).

The afferent vessels of the pulmonary ln. of the goat came from the deep part of the lungs, in accord with the ox (Koch, 1970). Its efferents in the goat joined the middle tracheobronchial ln. or the left tracheobronchial, in cases where the former was absent, resembling the ox (Koch, 1970).

Left pericardial lymph node The location and relation of this node in the goat agreed with the ox (Baum, 1912). In the latter the occurrence was higher, i.e., found in 84 percent of the cases (Baum, 1912), while in the goat it was present in 27.3 percent of the cases. No record was given in the sheep (May, 1970). Iwanoff (1947-1948) mentioned only that the node was inconstant in the goat. A second node was reported by Iwanoff (1947-1948) in the goat similar to the ox (Baum, 1912). In the specimen investigated, however, no other node(s) was seen.

The afferent vessels of the left pericardial ln. of the

goat resembled the ox (Baum, 1912), i.e., coming from the pericardium. Its efferent, however, coursed to the cranial mediastinal lnn., in contrast to the ox, where it joined the middle mediastinal or the left tracheobronchial ln. (Baum, 1912).

Right pericardial lymph node This node was not found in the goat. In the ox it was also very inconstant (Baum, 1912). Iwanoff (1947-1948) did not describe this node in the goat either.

Diaphragmatic lymph nodes These nodes, present in the ox (Baum, 1912), were not found in the goat, concordant with Iwanoff (1947-1948).

Infraspinatus lymph node This node, present in the ox (Baum, 1912), was not found in the goat. Iwanoff (1947-1948) did not describe the infraspinatus ln. in the goat either.

Subrhomboid lymph node This lymph node was reported by Iwanoff (1947-1948) in one of his specimen, but only on one side, located medial to the rhomboideus cervicis muscle and the cranial angle of the scapula. In the ox the subrhomboid ln. was found three times out of 20 cases (Baum, 1912). In the specimens investigated no subrhomboid ln. was found in the goat.

The thoracic duct The course and relationship of the thoracic duct of the goat basically agreed with the ox

and sheep, however, in all specimens investigated, no duplication occurred as reported in the ox (Dyce and Wensing, 1971). In the goat the duct crossed to the left on a level of the fourth intercostal space, while May (1970) reported the duct turned to the left on a level of the sixth thoracic vertebra in the sheep. Iwanoff (1947-1948) described that in the goat the duct crossed to the left between the third and fifth thoracic vertebrae. Similar to the ox (Sisson and Grossman, 1953) the thoracic duct of the goat was ampullated at its terminal part. The lymphaticovenous opening of the goat was also small.

Figure 15. The lymph nodes and lymph vessels in the thoracic cavity of the goat. Right side. ⊗ Injection sites

1 Costocervical ln.
2 Cranial mediastinal lnn.
3 Intercostal lnn.
4 Aortic thoracic lnn.
5 Middle mediastinal lnn.
6 Caudal mediastinal ln.
7 Cranial tracheobronchial ln.
8 Sternal ln.

A Sternocephalicus m.
B Longus colli m.
C Longissimus thoracis m.
D Spinalis et semispinalis dorsi m.
D' Spinalis et semispinalis cervicis m.
E Splenius
F Multifidus m.
G Diaphragm
H Heart (within pericardium)
I Aponeurosis of obliquus externus abdominis m.
L Intercostalis internus m.

a Cranial vena cava
b Left external jugular vein
b' Right external jugular vein
c Right subclavian artery
d Internal thoracic vein
e Costocervical vein
f Right azygos vein
g Thoracic aorta
i Trachea
j Thoracic duct
k Efferent of superficial cervical ln.
l Efferent of caudal deep cervical ln.
m Caudal vena cava
n Tracheal bronchus
o Right main bronchus (cut)
o' Left main bronchus (cut)

Figure 16. The lymph nodes and lymph vessels of the thoracic cavity of the goat. Left side. ⊗ Injection sites

1 Costocervical ln.
2 Cranial mediastinal lnn.
3 Intercostal lnn.
4 Aortic thoracic lnn.
5 Middle mediastinal lnn.
6 Caudal mediastinal ln.
7 Left tracheobronchial ln.
8 Left pericardial ln.
9 Sternal ln.

A Sternocephalicus m.
B Longus colli m.
C Longissimus thoracis m.
D Spinalis et semispinalis dorsi m.
E Splenius m.
F Longissimus cervicis m.
G Diaphragm
H Heart (within pericardium)
I Aponeurosis of obliquus externus abdominis m.

a Thoracic aorta
b Brachiocephalic trunk
c Left subclavian artery
d Internal thoracic artery
e Costocervical trunk
f Cranial vena cava
g Left external jugular vein
g' Right external jugular vein
h Left azygos vein
i Efferent of superficial cervical ln.
j Thoracic duct
k Esophagus
l Trachea
m Left main bronchus (cut)

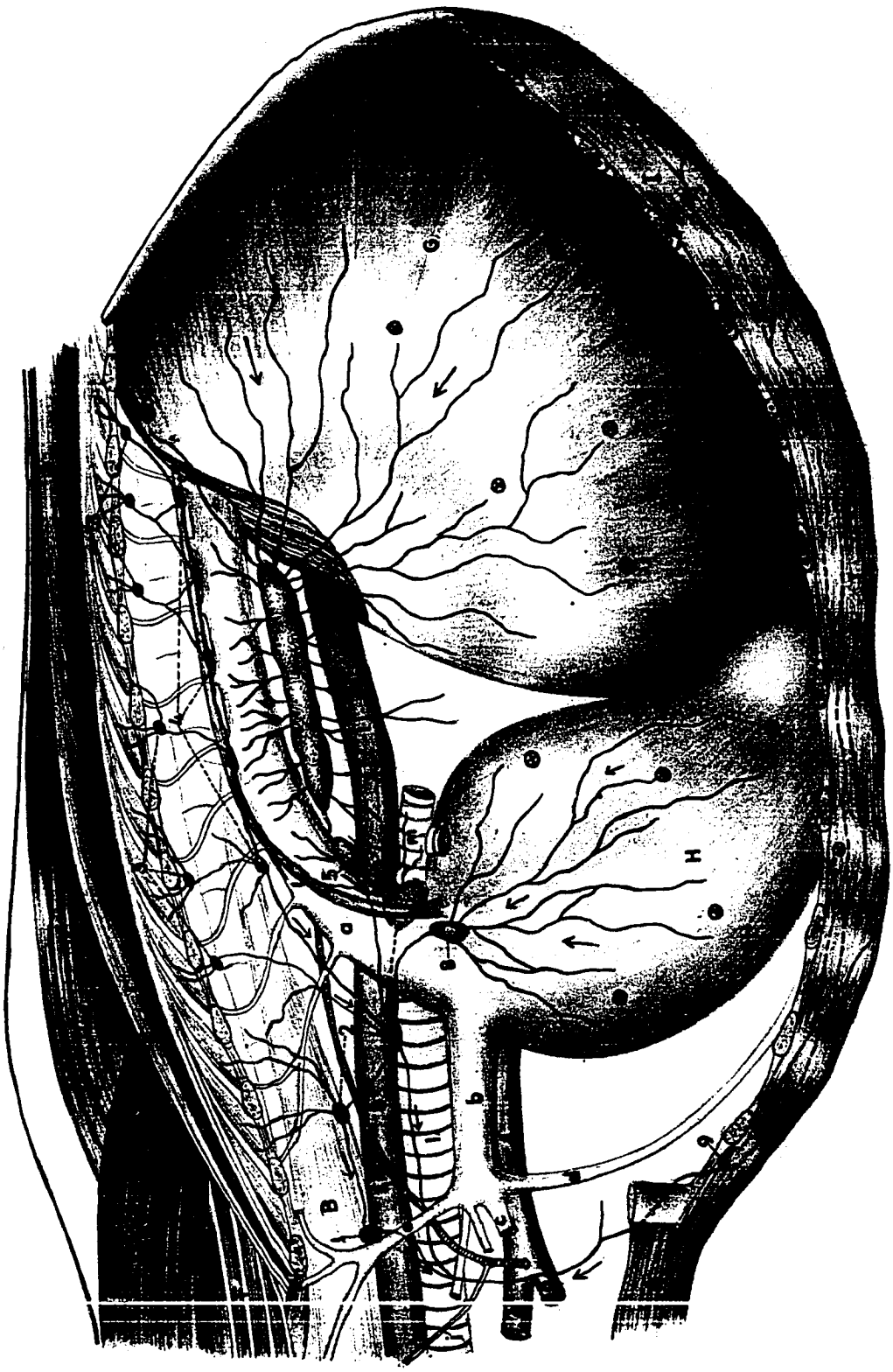


Figure 17. The lymph nodes and lymph vessels of the sternal region. The left transversus thoracis muscle has been removed. Dorsal view

1 Left sternal ln.
2 Right sternal ln. (cranial node)
2' Right sternal ln. (caudal node)
3 Afferent vessels to 2 and 2'
4 Internal thoracic vessels

A Xiphoid process

B Transversus thoracis m. (right side)

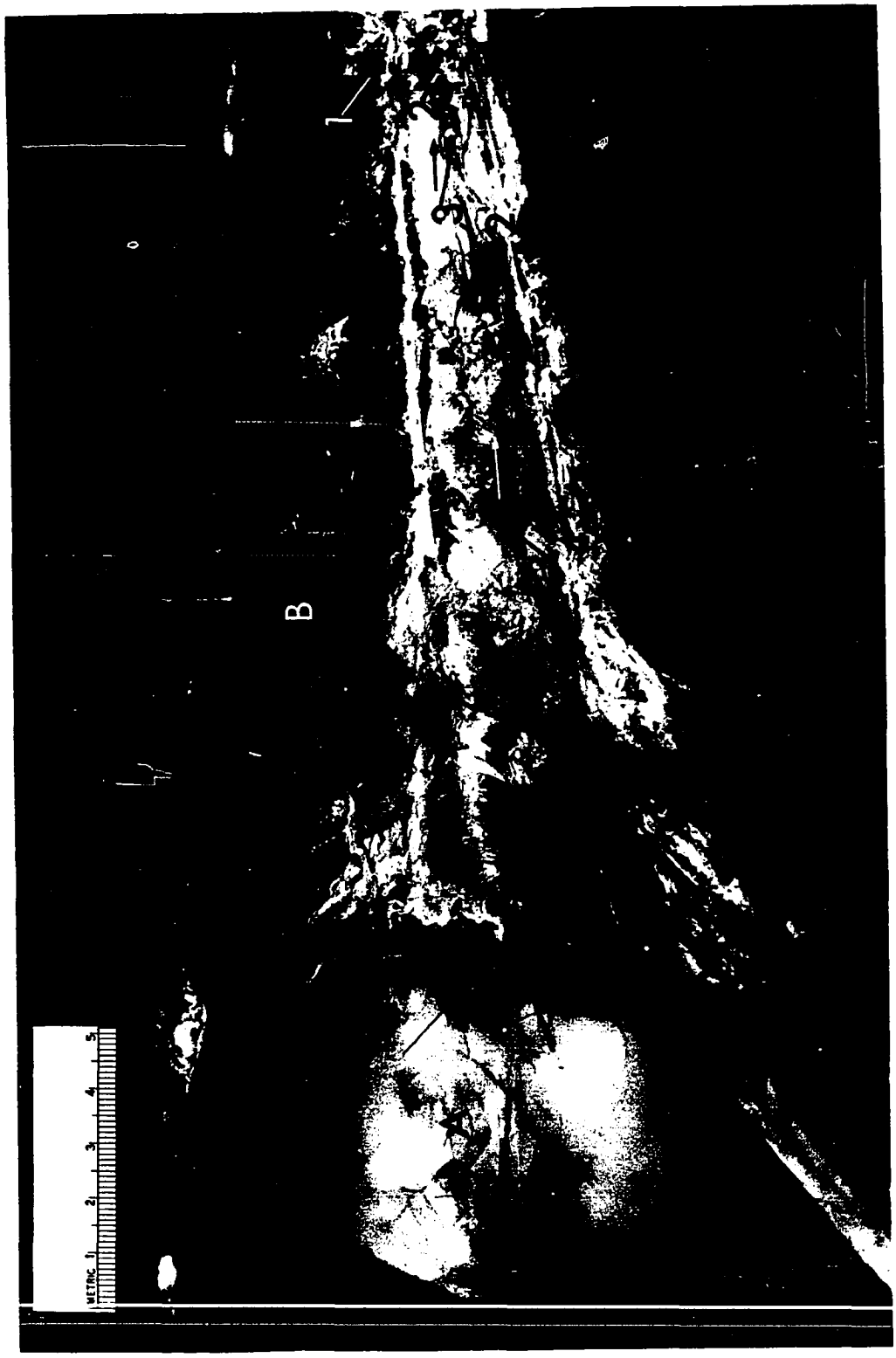

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Figure 18. Deep dissection of the thoracic cavity of the goat--region of the heart. The lungs have been removed. Right side

1 Cranial tracheobronchial ln.

a Trachea
b Tracheal bronchus
c Cranial vena cava
d Caudal vena cava
e Right phrenic nerve
f Right main bronchus
g Right lung
h Heart (within pericardium)

Figure 19. Deep dissection of the region of the tracheal bifurcation of the goat. The lungs have been removed. Dorsal view. Right side

1 Middle tracheobronchial ln.

a Trachea
b Right main bronchus
b' Left main bronchus
c Esophagus
d Left lung
e Caudal vena cava

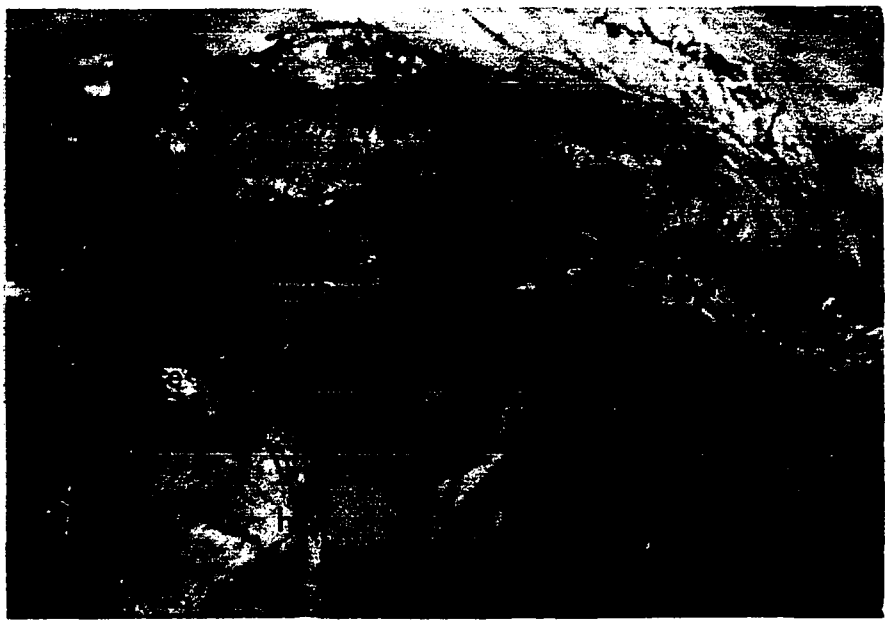


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Figure 20. Deep dissection of the thoracic cavity of the goat--region of the base of the heart. The lungs have been removed. Left side

1 Left pericardial ln.

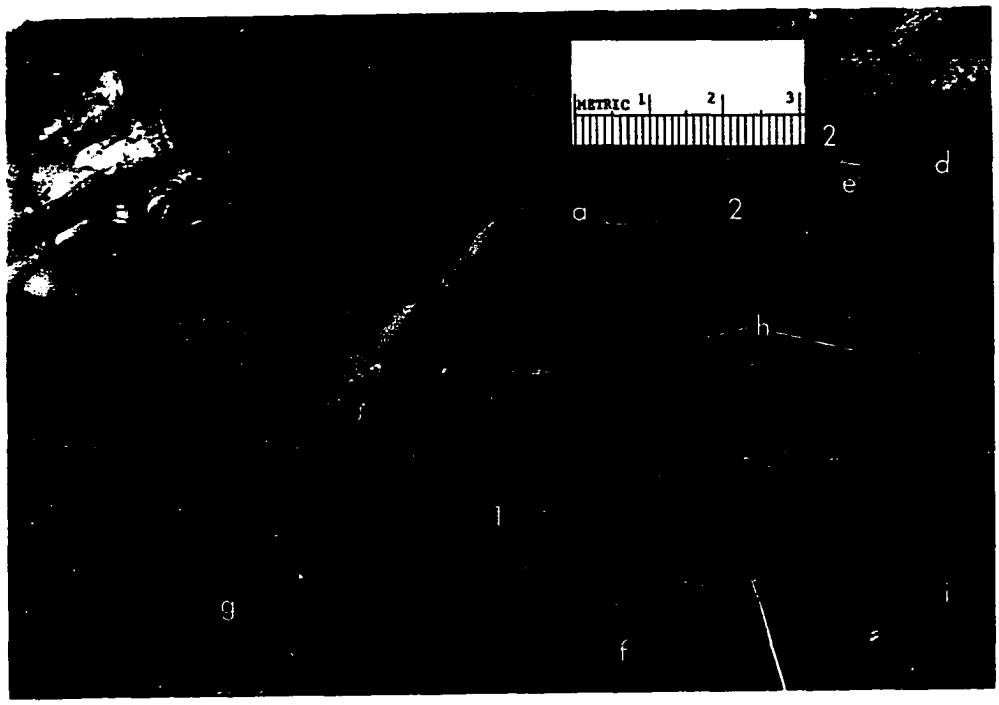
2 Middle mediastinal lnn.

a Left azygos vein
b Thoracic aorta
c Thoracic duct
d Esophagus
e Left vagus nerve
f Heart
g Left phrenic nerve
h Left bronchi
i Caudal vena cava

Figure 21. Deep dissection of the thoracic cavity of the goat--region of the base of the heart. The lungs have partly been removed. Left side (close-up)

1 Left tracheobronchial ln.

a Left azygos vein
b Thoracic aorta
c Esophagus
d Left vagus nerve
e Left recurrent laryngeal nerve
f Left phrenic nerve
g Heart (within pericardium)
h Left main bronchus
i Caudal lobe of left lung


METRIC 1 2 3
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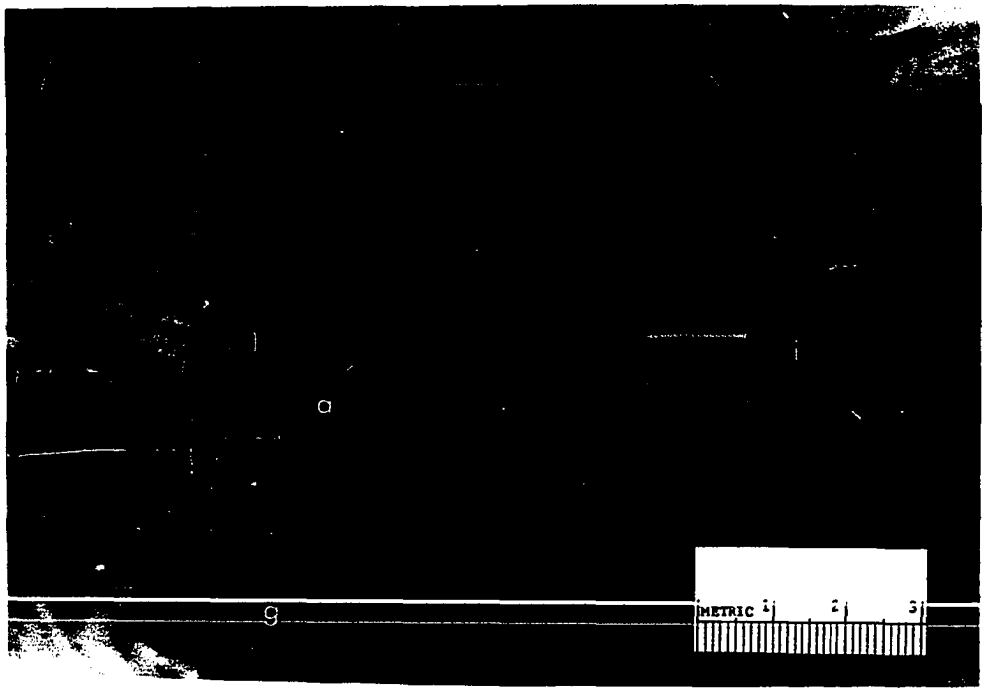
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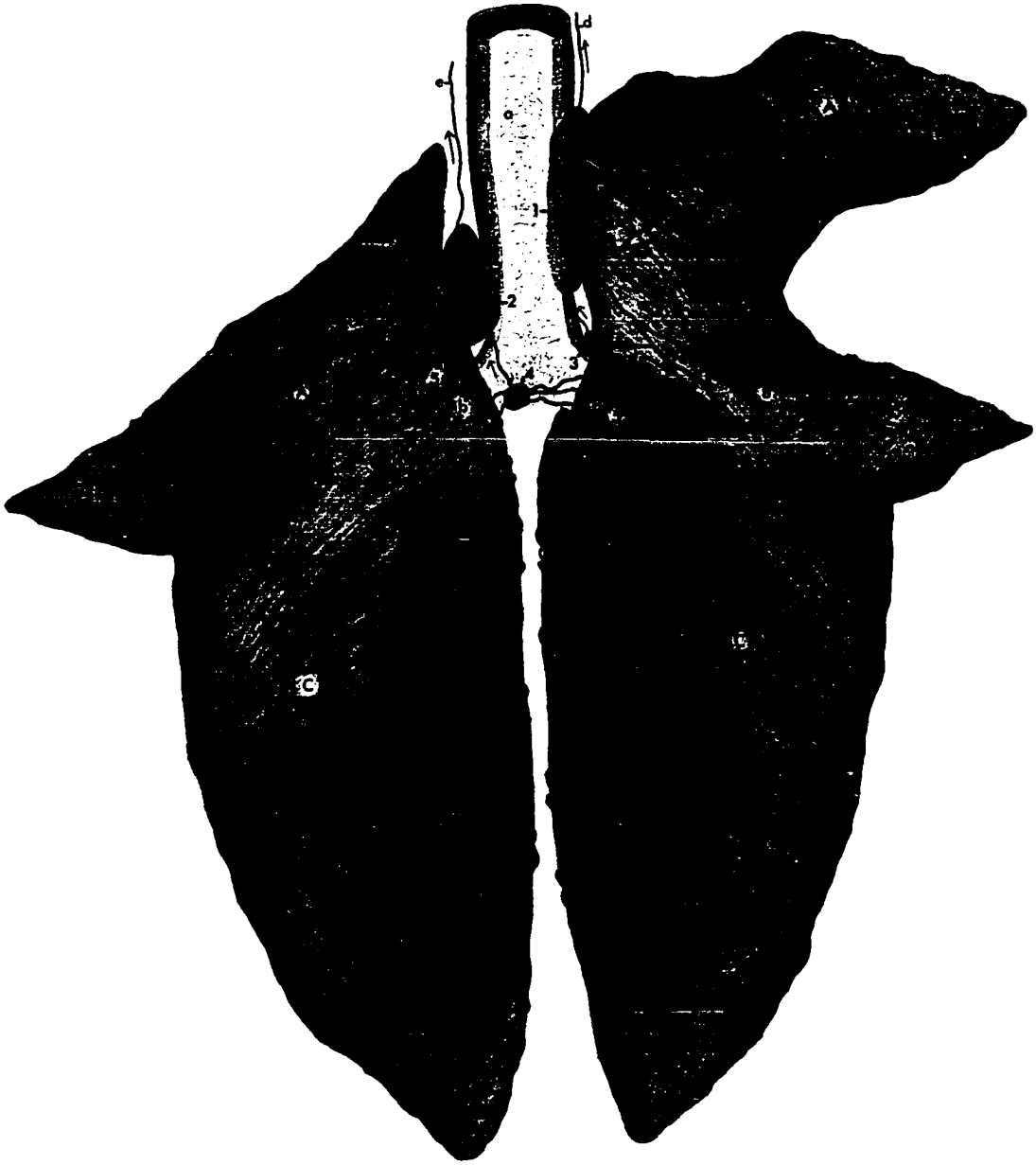
METRIC 1 2 3

Figure 22. The lymph nodes and lymph vessels of the bronchial region of the goat. Dorsal view. The light dotted parts of the lung (D) and lymph nodes (1, 2 and 5) were situated beneath the respective structures. ⊗ Injection sites

1 Cranial tracheobronchial ln.
2 Left tracheobronchial ln.
3 Right tracheobronchial ln.
4 Middle tracheobronchial ln.
5 Left and right pulmonary lnn.

A Cranial lobe
B Middle lobe
C Caudal lobe
D Accessory lobe (dotted)

a Trachea
b Right main bronchus
b' Left main bronchus
c Tracheal bronchus
d Efferent of 1 to right middle mediastinal lnn.
e Efferent of 2 to left middle mediastinal lnn.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C

Figure 23. The lymphatic drainage of the heart of the goat. Left side. ⊗ Injection sites

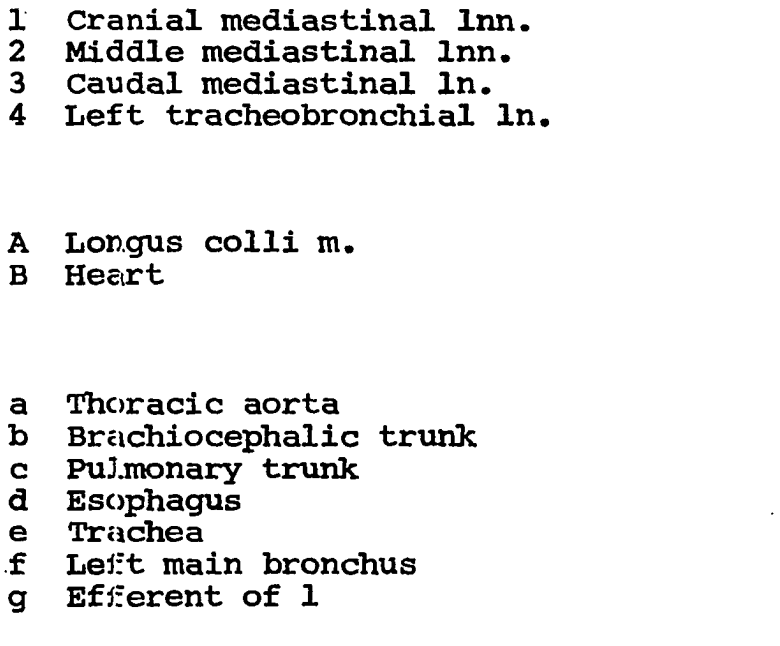
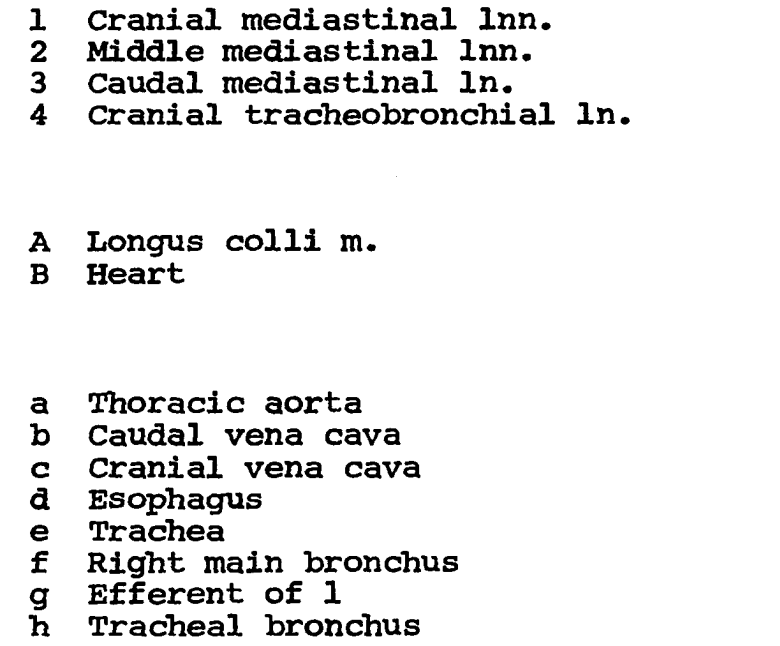


Figure 24. The lymphatic drainage of the heart of the goat. Right side. ⊗ Injection sites



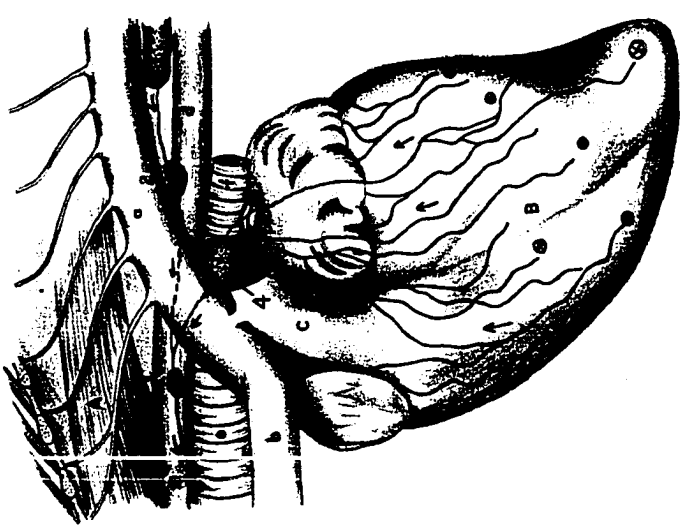


Figure 25. Lateral thoracic and abdominal wall of the goat. Right side. The purple spots were injection sites

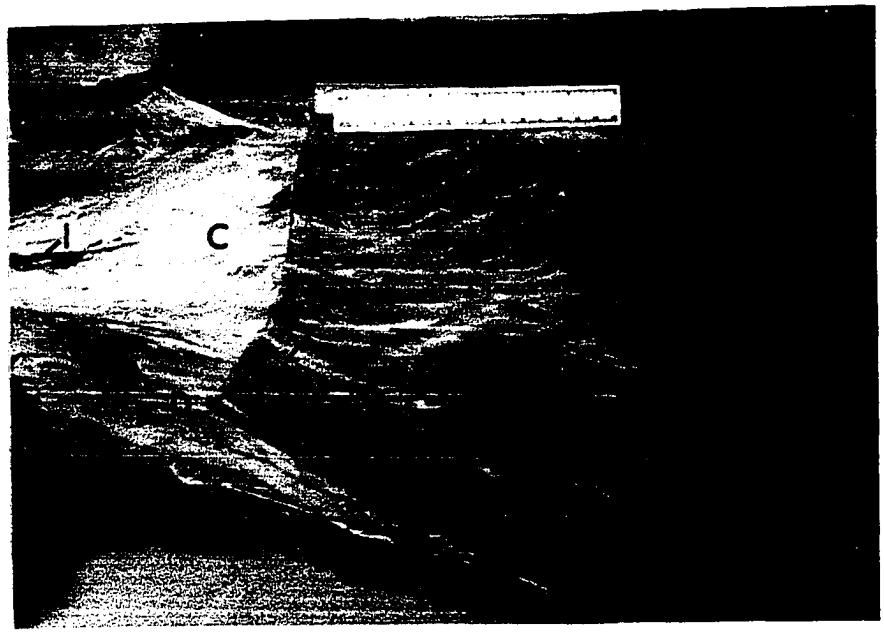
1 Subiliac ln.
2 Afferents from caudal part of thoracic wall

A Skin (reflected dorsally)
B Cutaneus trunci
B' Cutaneus trunci (caudal part cut and reflected dorsally)
C Aponeurosis of obliquus externus abdominis m.
D External lamina of rectus abdominis sheath

Figure 26. Lateral abdominal wall of the goat. Right side (close-up)

1 Subiliac ln.
2 Afferents to 1 from caudal part of thoracic wall

A Cutaneus trunci m. (caudal part)
A' Cutaneus trunci m. (cut and reflected dorsally)
B Obliquus externus abdominis m.
C External lamina of rectus abdominis sheath
D Obliquus internus abdominis m.


C

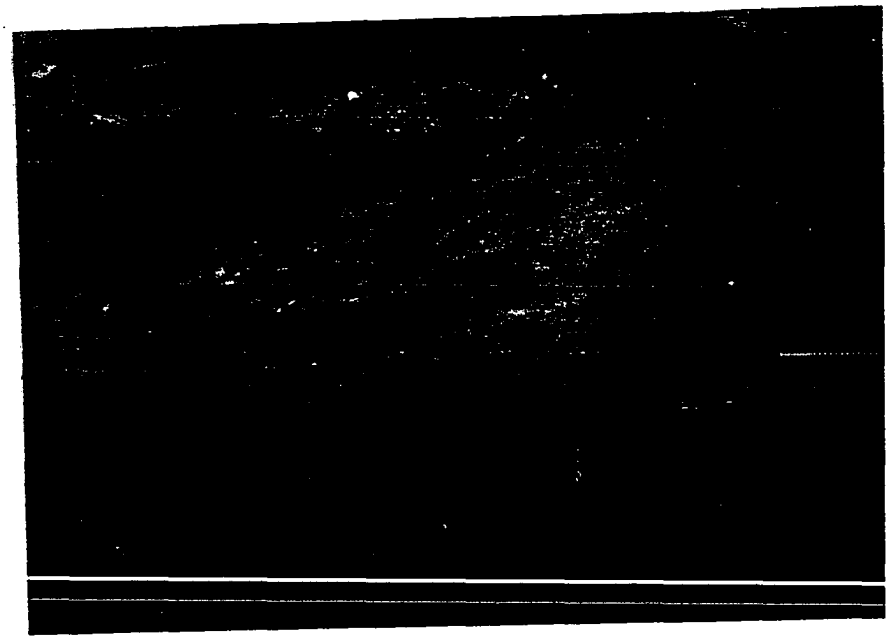


Figure 27. Abdominal region of the female goat. Specimen No. 4. Ventrolateral view (close-up)

1 Subiliac ln.
2 Afferents from caudal part of the thoracic wall to 1

A Cutaneus trunci m. (left side)
A' Cutaneus trunci m. (right side)
B External lamina of the rectus abdominis sheath


A'
B
2
METRIC 1
2
3

SUMMARY AND CONCLUSIONS

The lymph nodes and lymph vessels of the head, neck, thorax and thoracic limb of the goat (Capra hircus) were studied on eleven goats. The results were compared with the lymphatic structures of the same regions in the ox and sheep. Additional information was obtained from the heads of five goats and five sheep dissected by the freshmen students of the professional veterinary curriculum at the College of Veterinary Medicine, Iowa State University, Ames, Iowa.

Physiological NaCl solution of 2-5 percent Evans blue was used as injection medium. In some cases dog or sheep serum, or egg white, was added to enhance the absorption of the solution into the lymph vessels. Following anesthesia the solution was injected intracutaneously, subcutaneously, intramuscularly, intraarticularly and inthrthoracically. In one to one and a half hours following injection the animals were killed by exsanguination through the femoral artery. In three specimens the cranial vena cava was clamped, thus preventing the dye solution from the lymph vessels flowing into the venous system.

There were ten lymphocenters on each side of the body: three in the head, two in the neck, one in the thoracic limb and four in the thorax in accord with the Nomina Anatomica Veterinaria (1968). The results have shown that

each lymphocenter in most cases consisted of a single node, thus for a greater part presented a similar relationship with the ox and in a lesser degree with the sheep. It was, however, in contrast with other species (canine, equine and porcine), in which each lymphocenter comprised two or more lymph nodes. No difference of the mean and standard deviation of lymph nodes has been found by group, individual specimen, sex, age or between left and right side.

The lymph nodes and lymph vessels of the goat presented the following characteristics:

1. In the head region the parotid, mandibular, lateral and medial retropharyngeal lnn. were constantly found.

The parotid ln. was always completely covered by the parotid gland. Its afferent vessels came from most structures of the head, thus basically in agreement with the ox and sheep. Its efferent vessels joined the lateral retropharyngeal lnn.

The mandibular ln. presented the same location as in the ox and sheep. In most cases the afferent and efferent of this node maintained the same relationship as in the ox and sheep. In one specimen an efferent of the mandibular ln. joined the medial retropharyngeal ln. which has not been reported in the literature for the ox and sheep.

The lateral retropharyngeal lnn., two to three in number, frequently were in part covered by the caudal part of

the parotid gland. They received all lymph from the lymph nodes of the head and their efferents formed the lateral radicle of the tracheal trunk, thus presenting a different relationship than in the ox and sheep.

The medial retropharyngeal ln. was located at the same site as in the ox and sheep. Its afferent vessels came from most of the deeper structures of the head and the efferents formed the medial radicle of the tracheal trunk, thus also presenting a different relationship than in the ox and sheep.

The tracheal trunk of the goat was formed by two radicles, as indicated above, each of them arising as efferents of both lateral and medial retropharyngeal lnn. It received efferent vessels of the cranial and middle deep cervical lnn., when they were present. The trunk joined the caudal deep cervical ln. When two caudal deep cervical lnn. were present the lateral and medial radicle of the trunk, after uniting together, opened into the node of corresponding side of the neck.

The pterygoid and hyoid lnn. were absent, similar to the sheep.

2. In the neck region the superficial cervical and the deep cervical lnn. were present. The latter consisted of the cranial, middle and caudal deep groups.

The superficial cervical ln. was located at the same site as in the ox and sheep. Its afferent vessels came from the structures of the neck and cranial part of the thoracic wall caudally to the level of the tenth intercostal space. Its efferent vessel opened into the thoracic duct, external jugular or brachiocephalic veins.

The cranial and middle deep cervical lnn. were inconstant. They received the afferent vessels from their respective surrounding structures and their efferents joined the tracheal trunk or its lateral radicle.

The caudal deep cervical ln., usually one, was located on the ventral surface of the trachea in the caudal cervical region and received all lymph from the lymph nodes of the head and neck (except the superficial cervical). In one specimen two smaller nodes were seen close to the manubrium sterni, and might be comparable to the cervicalis caudalis manubrii sterni ln. of the ox (Baum, 1912).

The location of the costocervical ln. agreed, in general, with the ox and sheep. Its afferent vessels came from the surrounding structures of the node, and its efferent vessel joined the thoracic duct or the first rib axillary lnn. on the left. On the right it joined the cranial mediastinal lnn. or the cranial tracheobronchial ln.

3. In the thoracic limb two groups of lymph nodes were constantly found, viz. the proper axillary ln. and the first rib axillary lnn.

The proper axillary ln. was present in the same location as in the ox and sheep. Its afferent vessels came from the deep and superficial structures on the medial side of the thoracic limb and partly from the cranioventral part of the thoracic wall. Its efferents joined the first rib axillarly lnn.

The first rib axillary lnn. were located at variable places on the cranioventral part of the thorax, though the individual nodes were interconnected by lymph vessels with each other. Their afferents came from the cranioventral part of the thorax and efferents of the proper axillary ln. Their efferents joined the thoracic duct or efferent of the superficial cervical ln. of the respective side.

The infraspinatus and cubital lnn. were absent.

4. On the thoracic wall and within the thoracic cavity the following lymph nodes were constantly present:

The intercostal lnn., located in several intercostal spaces, received the afferent vessels from the structures of the dorsal and lateral thoracic wall and their efferents joined the aortic thoracic or the cranial mediastinal lnn.

The aortic thoracic lnn. were located at the same site as in the ox and sheep. Their afferent vessels for a greater part resembled the ox, however, no afferents were seen coming from the liver in the goat. The efferents of the arotic thoracic lnn. joined the cranial or middle mediastinal lnn.

The sternal ln. was located in the first intercostal space at the cranial border of the transversus thoracis muscle. Its afferent vessels came from structures surrounding the sternum, and its efferents joined the caudal deep cervical ln. or the superficial cervical ln.

The cranial mediastinal lnn. were located in the cranial mediastinum and received the afferent vessels from structures similar to the ox, however, none from the viscera. Their efferent vessels joined those of the costocervical ln.

The middle mediastinal lnn. were present on both sides of the thoracic cavity. Their afferents came from surrounding structures of the nodes. The efferents of the right and left middle mediastinal lnn. joined the cranial mediastinal lnn. of corresponding side.

In most cases the caudal mediastinal ln., usually single, received the afferent vessels partly resembling the ox, though no afferents were seen coming from the peritoneum, liver, spleen, middle mediastinal and pulmonary lnn. in the goat. Its efferent opened into the

right middle mediastinal lnn.

The cranial tracheobronchial ln. was large and might extend caudally until the tracheal bifurcation. Its afferent vessels came from the surrounding structures of the node and its efferent joined the cranial mediastinal lnn.

The left tracheobronchial ln., a single node in all specimens, was located at the same site as in the ox and sheep. Its afferent vessels mostly came from the surrounding structures and its efferents joined the cranial mediastinal lnn.

Inconstantly, however, were found the right and middle tracheobronchial lnn. (i.e., 18.2 percent and 27.3 percent, respectively), the pulmonary lnn. (18.2 percent) and the left pericardiac ln. (27.3 percent).

The right tracheobronchial ln. received the afferent vessels from the thoracic viscera and its efferent joined the cranial tracheobronchial ln.

The middle tracheobronchial ln. received the afferent vessels from the surrounding structures and its efferent joined the left tracheobronchial ln.

The pulmonary lnn. received the afferent vessels from the deep part of the lungs and their efferents joined the middle or left tracheobronchial ln. in cases where the former was absent.

The left pericardiac ln. received the afferent vessels from the left face of the pericardium, and its efferent joined the cranial mediastinal lnn.

The subrhomboid, right pericardiac and diaphragmatic lnn. were absent.

The thoracic duct of the goat was found to be a single duct and opened into the external jugular vein or the bi-jugular trunk.

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