

CLIMATE OF THOMASVILLE, GA. LATITUDE, 30° 50'; LONGITUDE, 84° 10'. PERIOD OF OBSERVATION, FIVE YEARS TEN MONTHS.

	January.	February.	March.	April.	July.	October.	No- vember.	De- cember.	Year.
Temperature—(Degrees Fahr.)									
Average monthly	52.15°	56.60°	61.55°	67.79°	82.35°	69.18°	58.56°	52.70°	
Mean of warmest	61.12	66.52	72.03	77.21	91.03	77.23	68.12	62.51	
Mean of coldest	43.19	49.08	54.0	61.97	79.14	63.32	51.72	45.18	
Average daily range	17.93	17.44	18.03	15.24	21.89	13.91	16.40	17.33	
Highest or maximum	78.0	82.0	88.0	91.0	101.5	94.5	84.5	79.5	
Lowest or minimum	14.0	28.0	32.0	36.0	66.0	37.0	26.0	10.0	
Humidity—									
Average mean relative	63.7%	62.8%	62.3%	62.3%	66.0%	68.2%	66.6%	64.7%	65.16%
Precipitation—									
Average in inches	3.41	3.36	3.92	5.28	4.69	5.19	2.69	3.85	51.56 S. S. W., S. E., and N. W.
Wind—									
Prevailing direction	S. and N. W.	S. and N. W.	S.	S.	S.	S.	S. and S. W.	S. and N. W.	S. E., and N. W.
Average hourly velocity in miles	5.0	5.0	9.0	8.0	3.0	7.0	8.0	7.0	5.8
Average number of fair and clear days	23.0	22.0	24.0	21.0	20.0	24.0	24.0	24.0	26.9

peditions, either all the way by rail or by steamers from Boston or New York to Savannah, and thence by rail.
Edward O. Otis.

THOMSEN'S DISEASE. See *Muscle, Pathology of.*

THORACIC DUCT.—The thoracic duct, the large lymph channel of the body, runs from the receptaculum chyli to the left side of the neck, where it terminates at the angle of junction of the left subclavian and internal jugular veins. The receptaculum chyli is located on the anterior surface of the body of the second lumbar vertebra, and is a dilatation of the lower end of the duct, into which empty a large number of lymphatics and lacteals, from the lumbar region and the organs of digestion. This pouch is not always present, its place being

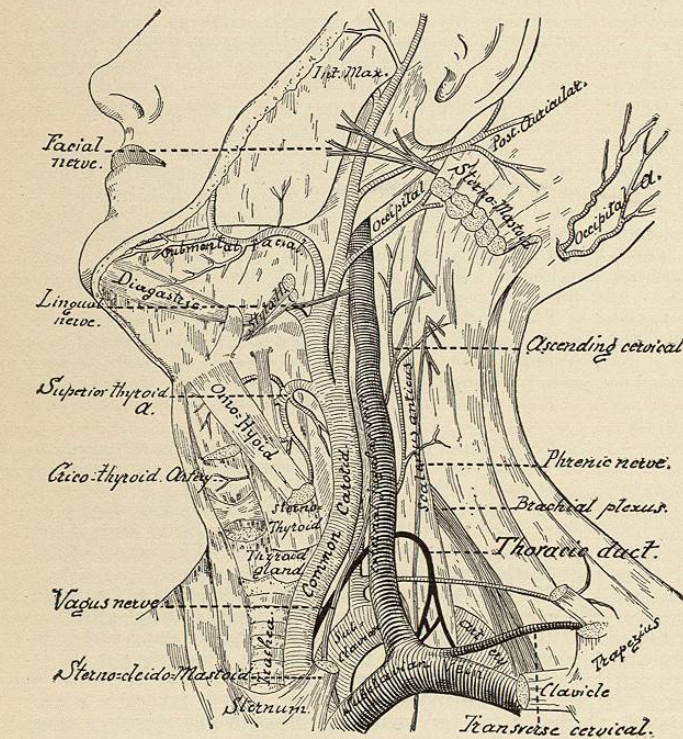


FIG. 4709.—Cervical Relations of the Duct in the Neck, showing a terminal arrangement frequently seen. The duct here divides into three terminal branches, emptying into the internal jugular (erroneously labeled 'external jugular' in the cut), the subclavian, and the transverse cervical veins, with a cross branch connecting the first and second branches. (From a drawing by G. R. Egeland, from a dissection from the dissecting room of the Northwestern University Medical School, Chicago.)

sometimes taken by a network of lymph vessels which unite to form the duct. This vessel has its course upward and to the right, on the anterior surface of the lumbar vertebrae, to the right of the aorta, in company with which it passes between the two crura of the diaphragm and enters the thorax. It now ascends on the dorsal vertebrae, lying between the thoracic aorta and the right vena azygos, and behind the posterior parietal pleura. At the fifth dorsal vertebra it curves to the left, and passing behind the transverse portion of the aorta, runs upward and to the left behind and slightly internal to the left subclavian artery. Passing into the neck, it now lies on the anterior surface of the scalenus anticus muscle, under the deep layer of fascia that lies over the muscle. The point to which it rises in the neck varies considerably. It may pass outward to the angle of junction of the subclavian and internal jugular veins, and empty by a single trunk into the veins as they unite to form the left innominate, never rising above the level of the upper border of the subclavian vein. This is the form which is least likely to be injured in surgical operations, as it is well protected by the deeper structures. It may ascend on the anterior surface of the scalenus anticus, as high as 6-6.5 cm. above the upper border of the first rib, or to the level of the middle of the thyroid gland. In these cases it curves downward and outward and frequently splits into a number of branches which may re-unite and form a single trunk, or may empty separately into the subclavian or internal jugular veins, or both; into the vertebral or the transversalis colli veins; or into any combination of these veins, depending upon the number of branches in the particular instance. After injecting and dissecting some fifty specimens, I am unable to state any fixed rule for the distribution of the cervical portion of the duct, or to formulate any systematic classification of the different variations of termination. It can, however, be said that, as a general rule, the higher the duct rises in the neck, the more likely it is to have terminal branches. When the duct is a single trunk, it generally lies low. The cervical portion is the only part that is of practical importance, from a surgical standpoint, as it is the only part that is exposed to surgical interference. The terminal portion of the duct, or the terminal divisions, if there are any, will always be found on the anterior surface of the scalenus anticus, or under the deep fascia covering the muscle, behind and internal to the last portion of the internal jugular vein. Where the duct rises high in the neck and presents many branches, it very frequently has a branch lying behind the clavicle, in the thorax, and emptying into the posterior portion of the

subclavian vein. In case of injury to the cervical portion of the duct, this branch alone would suffice for furnishing collateral circulation.

Anomalies.—Besides the multiple endings of the duct, which are so common as to be normal, the most frequent anomaly observed is that of the duct terminating in the right subclavian vein inside of the left. This has been frequently observed and is generally found associated with vascular irregularities, especially with absence of the innominate artery, with the right common carotid and subclavian arteries springing directly from the arch of the aorta. In such cases the thoracic duct takes the place of the right lymphatic duct, and the left duct has a corresponding course and relation usually found in the normal duct on the right side. Less frequently seen is a duct, double throughout, one portion going to the subclavian vein on each side, the two ducts being connected by numerous cross branches. Occasionally one finds a duct, single as far as the fourth or fifth dorsal vertebra, then dividing and sending a branch to the vein on each side. Cases of anomalous course or distribution have been reported by Thompson, Watson, Cruickshank, Krause, Paturban, Thomson, and Brinton. Thomson suggests that there are probably developmental reasons for these anomalies.

Physiology.—The function of the thoracic duct is to convey the chyle from the digestive system and the lymph from the lumbar glands to the blood of the right heart. It is not known what constitutes the force that pumps the lymph from the abdominal cavity to the termination in the left side of the neck. Weiss found that the pressure in the duct was equal to from 9 to 15 mm. of mercury. The flow of blood through the arch of the aorta, the action of expiration and inspiration, and the motion of the heart, as well as intrathoracic pressure, and the force of the flow of blood in the left innominate vein, are probably all factors in producing and maintaining the lymph flow. I have repeatedly found it impossible, in the cadaver, to inject the duct from the abdominal cavity until the heart and lungs were removed.

As to the composition of the fluid found in the duct of the human being, several analyses have been made. Rees, in 1843, analyzed the lymph taken from the duct of a recently executed criminal. Seyler took the contents of a pleuritic effusion caused by the rupture of a duct in the thorax. Hasebrook obtained and examined the fluid of a chylous pericardial effusion. Paton, in 1890, made three analyses of the fluid obtained from a chylous fistule following an operation for sarcoma of the neck. As it is impossible to say how greatly the chyle may be modified by absorption from a serous cavity, the results of the second and third observers are somewhat discredited. Rees and Paton, therefore, are best worthy of consideration. Their analyses gave the following results:

	Rees.	Paton.
Water	904.8	951.6
Solids	95.2	51.7
Organic	90.8	41.91
Proteids	70.8	12.53
Fats	9.2	26.06
Inorganic	4.4	6.49

In regard to the rate of flow, Paton found that it averaged from 1 to 3 cub. cm. per minute, or from 1,584 to 4,752 cub. cm. per twenty-four hours. The weight of the patient was 60 kgm. Therefore the flow was from 2.64 to 7.93 cub. cm. per 100 kgm. of body weight.
Frederick R. Green.

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THORACIC DUCT, PATHOLOGY OF.—Not many pathological conditions of the thoracic duct have been reported. This may be explained in part by the fact that anastomoses are frequently present, and consequently the symptoms which would have been caused are masked or absent. At other times the region in which the duct lies is examined at autopsy very superficially if at all, and consequently some pathological conditions are not seen.

Anomalies.—Anomalies of the thoracic duct are not uncommon. The duct may lie on the right side of the vertebral column; it may have two or three outlets into the subclavian vein, or it may be double throughout its entire course. In other cases the main trunk may divide to form a plexus of lymph vessels in the posterior mediastinum, the radicles uniting to form a single trunk which empties into the subclavian vein in the usual manner. Besides these more common varieties, other anomalies may occur, that reported by Svitzer⁶⁵ being one of the most peculiar. In his case the duct partially encircled the aorta and emptied into the left subclavian vein.

Hemorrhage.—Hemorrhage into the duct may result from trauma to the duct, or may be present in severe anæmias or leukæmias. In cases of congenital or acquired hæmophilia in which retroperitoneal hemorrhages occur, or in cases of injuries to the intestines, the contents of the duct may contain a variable amount of blood. In any case in which blood is present in the duct it may remain fluid, but if the quantity becomes very great, coagulation may result and a large clot form, which may cause obstruction.

Thrombosis.—According to Leydecker¹ thrombosis of the thoracic duct may follow lymphangitis, trauma, pressure from tumors, aneurisms, and exostoses of the vertebrae, or may accompany lesions of the heart valves. Usually these thrombi are recent, as was the one seen by Turney.² The patient gave a history of chylothorax and chylous ascites, and at autopsy Turney found a thrombus at the mouth of the duct, extending downward a short distance and completely blocking the lumen. Below the obstruction the duct was greatly dilated, as were all its radicles. All the superficial lymphatics of the upper extremity were also dilated.

Oppolzer⁴⁶ reported a case in which no history nor signs of chylothorax nor chylous ascites were given. The patient had a valvular lesion, and at autopsy Oppolzer found that a clot obstructed the mouth and, for a short distance, the lumen of the duct.

Cayley reported a case in which a similar pathological condition was found. The patient was a young man, nineteen years old, whose chief symptoms were constipation and pain in the abdomen. He gave signs of chylous ascites, but none of chylothorax. Further examination showed the presence of a large retroperitoneal tumor which at autopsy proved to be a greatly dilated receptaculum chyli and its radicles. The thoracic duct was dilated, and at its mouth Cayley found a clot which closed the outlet of the duct.

In other cases the thrombi undergo partial or complete organization, so that the lumen may become partially or wholly occluded by a mass of connective tissue canalized by new blood and lymph vessels. Such a condition was seen by Heller.³

Retrograde Changes.—The only case of necrosis of the thoracic duct which has been reported as yet is the one quoted by Noehher,⁴ and in the light of modern pathology his diagnosis and autopsy findings might be questioned. He diagnosed the case as "malignant epi-

demic fever," and at autopsy, a few hours after death, found what he called a "gangrenous thoracic duct."

Here might be mentioned two cases which are interesting, in that they show changes analogous to those found in old sclerotic arteries. Brown-Cheston¹⁴ and Assalini¹⁷ have reported a case each, in which they found a thoracic duct, the wall of which was converted into a calcified tube.

Aneurisms and Cysts.—Many dilatations of the thoracic duct have been mistaken for aneurisms or cysts. Some of these could be explained easily by dilatation caused by some obstruction to the flow. On the other hand, cases of dilatation have been reported which could not be explained by any increased pressure within or without the duct. Such conditions are comparable with the formation of aneurisms of arteries and veins, in that the walls become atrophied and a localized dilatation follows. Cases showing this condition have been reported by Laënnec,³² Albers,³⁴ Bromann,³⁵ Kilian,³⁶ Küster,³⁷ Enzmann,⁹ von Winiwarter,³⁸ Weichselbaum,³⁹ von Recklinghausen,⁴⁰ Bostroem,⁴¹ Rokitsansky,⁴² Fitz,⁴³ Tillaux,⁴⁴ and Ramonet.⁴⁵

Pigment Deposit.—In chronic obstructive jaundice the contents of the duct may become golden-brown to green in color, due to the presence of the bile constituents, and the walls of the duct may become deeply tinged also.

Progressive Changes.—Inflammations about the duct often cause secondary changes in the wall of the duct, producing localized or general thickenings, which may become so marked that the lumen is markedly occluded.

Heller³ reported such a case in a woman, aged fifty-six, who had marked edema of the pelvic tissues accompanied by ascites. At autopsy he found that the wall of the thoracic duct was greatly thickened throughout, and that its lumen was almost completely obliterated. He explained this thickening as inflammatory. Andral⁷ reported a similar localized finding. In his case the lumen of the duct was greatly reduced by a localized increase of scar tissue at the level of the fifth dorsal vertebra.

In cases of puerperal sepsis or general septicæmia in which the abdominal lymph vessels contain pus, or the mesenteric glands are the seats of secondary abscesses, the thoracic duct may become involved. In such cases its walls become swollen, due to congestion, œdema, and infiltration with leucocytes, and its lumen may contain pus. In these cases general pyæmia, if not already present, usually results.

Cases in which pus has been found at autopsy in the thoracic ducts have been seen by Adams,⁵ Worms,⁶ Andral,⁷ Gendrin,⁸ Enzmann,⁹ and Schweininger.¹⁰

Tuberculosis.—When it is considered how often the bronchial or mesenteric lymph glands are affected with tuberculosis, it seems strange that more cases are not reported in which the thoracic duct is involved secondarily, on the one hand through its close proximity, and on the other through its direct communication with the seat of infection. That the condition is not so rare as the few reported cases would indicate is shown by Stilling, who found tubercles in the thoracic duct of five in a series of eighteen cases of general miliary tuberculosis.

Cooper¹¹ in 1798 was the first to observe tuberculosis of the duct. His case was one of general tuberculosis, and at autopsy he found several caseous masses behind some of the valves of the duct. Ponfick,¹² in 1877, pointed out the significant fact that many cases of general miliary tuberculosis were due to a secondary involvement of the duct from tuberculous bronchial lymph glands, with subsequent dissemination of the tubercle bacilli through its stream into that of the blood. He was able to demonstrate this fact in a case which he reported, and drew the conclusion that it was possible in many cases to trace the sudden generalization of tuberculosis to a similar source. Since the report of his case, Benda¹³ and Stilling¹⁴ have made similar observations, and have confirmed the conclusions drawn by Ponfick.

In some cases the lumen may become markedly obstructed and the walls of the duct greatly thinned, owing

to the presence of large caseous masses blocking the lumen. In other cases only scattered tubercles are present, either behind a valve flap or between two valves. These scattered tubercles are for the most part small semitransparent grayish nodules varying in size from a pin point to a pinhead. Sometimes many of these tubercles coalesce and form a mass, slightly elevated above the surface, about the size of a split pea. The tubercles are closely adherent to the intima, and when pulled off leave a depressed bleeding ulcer with edges slightly undermined. If the bacilli lodge behind a valve flap, tubercles form which rapidly caseate and coalesce, forming a semi-solid grayish-yellow mass which pushes the valve out into the lumen and sooner or later causes obstruction to the flow in the lumen.

Besides the observers mentioned, Talma,¹⁵ Nasse,¹⁸ Poncy,¹⁹ Cruikshank,²⁰ Hopfgärtner,²¹ Lieutaud,²² Otto,⁶¹ Weigert,²³ Brash,⁶⁵ Schurhoff,⁶³ and Whittla⁶⁴ have reported cases of tuberculosis of the thoracic duct.

Tumors.—As yet no cases of the mature connective-tissue tumors in the walls of the thoracic duct have been reported.

Sarcoma.—A few instances of this class of tumors have been reported. Rust,⁶² in 1815, was the first to observe a sarcoma in the thoracic duct. Otto,⁶¹ in 1824, saw another case. Both cases were secondary to a sarcoma in the testis. The third case in the literature was reported by Winkler²⁸ in 1898. His patient was a young man, twenty years old, who had a mediastinal tumor. At autopsy Winkler found that the wall of the duct was irregularly thickened, and in areas he found distinct secondary nodules. Microscopically the mediastinal tumor and its secondaries were found to be round-cell sarcoma. One case of metastatic sarcoma of the duct has been seen at the Pathological Laboratory of the University of Michigan. The primary was a malignant teratoma of the testis which had given rise to a secondary sarcoma in the receptaculum chyli, about the size of an English walnut. The lumen was completely occluded.

Carcinoma.—Although carcinomata of the abdominal and pelvic organs frequently give rise to secondaries in the thoracic organs, it is not common to find the thoracic duct involved by secondary growths. This may be due, partly, to the fact that the thoracic duct has but few valves, and these are rudimentary, so that cancer cells do not lodge readily; but it must be admitted that this is a very insufficient reason. In 1898 Winkler²⁸ collected all the cases of carcinoma of the thoracic duct, which had been previously reported. He found fifteen in all, and added eleven more of his own; but from his study of these cases he drew no definite conclusion as to this infrequent involvement of the thoracic duct, unless it be that this organ is seldom examined at autopsy, and then often very superficially.

Of the 26 cases of secondary carcinoma of the duct 10 were primary in the stomach (Acker,²⁴ Leydecker,¹ Hektoen,²⁵ Barybuhr,²⁶ Pannenburg,²⁷ Winkler²⁸); 8 in the uterus (Andral,⁷ Winkler,²⁸ Enzmann,⁹ Unger²⁹); 3 in the gall-bladder (Behrens,³⁰ Winkler²⁸); 1 in the testis (Cooper¹¹); 1 in the pharynx (Virchow³¹); 1 in the ovary (Senator³²); 1 in the right adrenal (Winkler²⁸), and 1 in the kidney (Winkler²⁸). In all cases secondary growths were present in the retroperitoneal lymph glands. Some authors mentioned secondary nodules in the lungs or cervical lymph glands, but they were not common.

The nodules in the duct may be small and not easily outlined, or they may be so large that they partially or wholly close the lumen of the duct. In such cases dilatation occurs behind the obstruction, and unless the anastomoses can cope with the lymph thus held back, chylo-thorax, chylous ascites, or both, may result, depending upon the grade of obstruction and the location of the tumor masses.

Parasites (see article on *Parasites*).—Of the parasites found in man, cases have been reported in which cysticerci and filaria have been found in the lumen of the thoracic duct.

Rupture.—Traumatism of the thoracic duct, resulting

in rupture, may be due to an injury of the thorax, or may be caused during an operation in the lower left cervical region. Traumatism of the first sort are not common because of the protected position of the duct; nevertheless in severe injuries of the thorax and abdomen or as the result of severe straining, such as severe coughing, rupture of the duct may occur. Manley⁴⁹ reported a case of rupture of the duct in a young man who had received a severe blow over the abdomen, followed by symptoms of peritonitis, accompanied by a fluctuating, non-reddened swelling in the right iliac fossa, which contained chyle. This sac was drained for fifteen days and healed. Manley thought that the duct had been ruptured, but since he did not open the peritoneal cavity other than to drain the sac, it cannot be positively stated that his diagnosis was correct.

The first authentic case of rupture of the duct was one cited by Monroe⁵⁰ in 1765. The patient had had chylous ascites, and at autopsy he found a rupture of the duct at the level of the fourth dorsal vertebra. Kirchner⁵¹ was able to find only seventeen cases in the literature in which the rupture resulted directly from trauma. To these he added another of what he considered a traumatic rupture. The patient was a child, nine years old, who had fallen against a window sill, injuring the thorax. In ten days this was followed by marked dyspnea and ascites. Aspiration showed the presence of chyle in the abdomen. These symptoms persisted for ten days and then gradually disappeared.

Since then Eyer,⁵² Port,⁵³ and Lyne⁵⁴ have reported cases in which there could be little doubt that the duct was ruptured, since chylous ascites and chylothorax were present in every case.

Rupture of the duct may occur during operations for the removal of sarcomatous, carcinomatous, or tuberculous lymph glands of the left lower cervical region, but that this is not a common occurrence is shown by the few cases reported and by a series of thirty-five cases cited by Cushing in which the lymph glands of this region contained secondary new growths. Rupture of the duct during their removal occurred in only two cases.

The rupture may be noticed at the time of the operation, or it may escape observation altogether until the wound is subsequently dressed. If noticed at the time of the operation, the rupture is usually recognized by a sudden gush of milky fluid. Sometimes it may be a serous fluid. If not noticed at the time of rupture, it may be recognized by the presence of a milky or opalescent fluid in the wound or on the dressings at a subsequent visit.

These ruptures are not usually fatal, although a large amount of the contents of the duct may be lost. Paton,⁵⁶ on the other hand, reported a case of rupture in which 1,584, 3,168, and 4,752 c.c. of chyle were lost on three consecutive days; death followed soon afterward. Thöle⁵⁵ in 1900 was able to find in the literature fifteen cases of rupture of the duct during operation and added a personal case. Besides those collected by them, Paton,⁵⁵ Schoff,⁵⁷ Allen and Briggs,⁵⁸ Weischer,⁵⁹ and Cushing⁶⁰ have reported cases.

Most of these surgeons either pack the wound tightly or ligate the duct, and the rupture then heals.

Frederick A. Baldwin.

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THORAX.—The thorax is that part of the great body cavity which is situated above the diaphragm. It contains the organs of respiration and circulation, together with many large vessels and nerves. It is in shape the form of a truncated cone with the base directed downward and formed by the diaphragm, and the truncated apex continuous with the root of the neck. Superficially the thorax presents an anterior wall, two lateral walls, and a posterior surface. The anterior thoracic wall is separated above from the anterior surface of the neck by the prominent ridge of the clavicle, joining the upper and outer angle of the first piece of the sternum to form the prominent sterno-clavicular articulation. Between the inner extremities of the two clavicles and above the upper border of the sternum, we find the deep suprasternal notch. Running downward in the median line to the tip of the ensiform cartilage is the midsternal line, which in the living subject is indicated by a furrow between the sternal attachments of the pectoralis major muscle on each side. Along the outer border of the sternum is the sternal line. At the junction of the first and second pieces of the sternum is a transverse ridge known as Ludwig's angle, which marks the attachment of the second costal cartilage to the sternum. As the first rib is not palpable, on account of its position behind the clavicle, Ludwig's landmark is commonly used in counting the ribs on the living subject. Extending vertically through the nipples on each side is the mammillary line. Half-way between the sternal line and the mammillary line and parallel to them is the parasternal line. The anterior axillary line is drawn vertically downward from the point where the anterior axillary fold, or the lower border of the pectoralis major, joins the chest wall. The posterior axillary line is drawn from the posterior axillary fold, which is formed by the latissimus dorsi. Mid-way between these two lines and extending downward from the highest point or apex of the axilla is the mid-axillary line. The surface markings on the posterior surface of the thorax are few. In the median line we have