month, it becomes greatly enlarged again at the end of gestation. The second or third day after delivery the milk begins to be secreted, and now the true functional activity of the gland is first established. The milk accumulates in the alveoli and in the excretory ducts. The gland becomes harder, heavier, and more voluminous. It soon acquires a volume two or three times that of the gland before pregnancy.

After lactation it returns again to its ordinary size, which it retains until another pregnancy and another period of activity. It is now less smooth, firm, and elastic than the virgin mamma.

After the menopause the useless gland with the rest of the genitals becomes atrophied. The glandular and secreting structures are frequently replaced by fat, when but little reduction in size occurs. In other cases this does not occur, and the entire gland is reduced to a small fibrous area around the nipple and immediately beneath the skin. Thus it returns at last to a condition approaching the infantile.

The two breasts are seldom equal in size, the left usually being the larger, sometimes quite considerably. This is thought to be due to the fact that women nourish the child more on that side.

The size of the breasts presents considerable ethnological variations. Huschke says that, as a rule, they are more voluminous in warm than in cold countries, and in moist countries and in valleys than in dry countries and mountains. As regards races, variations are considerable, the people of southern Africa being remarkable for their large and pendent breasts.

In individuals, the size of the breast offers considerable variations. It appears that the development is independent of the build and constitution; large, robust women are frequently seen with very poorly developed breasts, while, on the other hand, small women are seen with large, well-formed breasts.

The mammæ are formed of stroma containing fat and the essential gland structure. It is therefore clear that size alone will not determine the activity of the gland. A breast may be formed of a maximum amount of stroma and a minimum amount of parenchyma (fatty mammæ), or of a maximum amount of gland tissue and a minimum amount of fat (glandular mammæ). For this reason large breasts may furnish much less milk than much smaller ones.

De Sinéty has pointed out that city-bred women are likely to have breasts much more poorly developed and functionally less active than their country sisters. This he attributes to the social conditions in the city leading so often to the wet-nurse and bottle, and he believes that this, carried through several generations, has led to an inherited characteristic. Thus the breast is following the

FIG. 1042.—A Part of the Ventral Surface of the Corpus Mammæ, Showing the Branchings of Two Milk Ducts. (Henle.)

law of morphology, that those organs which have become functionless and useless gradually are less and less developed and finally disappear.

Structure.—The breasts are composed essentially of three parts: first, the mamma proper; second, the covering skin; third, the surrounding fatty tissue. The mammæ, like all glands, consist of two parts: the parenchyma, and the stroma. The latter includes the fat, which is embedded in it, also the blood-vessels, lymphatics, and nerves, which ramify through it. The parenchyma is divided into a central compact part, the body or corpus mammæ, surrounded by peripheral processes. It is made up of lobes (lobi mammæ) divided into lobules (lobuli mammæ). All of the lobules of a lobe empty by small into larger ducts. These ultimately lead to one large duct (ductus lactifer), which opens upon the nipple (papilla mammæ) (Figs. 1042 and 1043).

When the covering parts are removed, the gland presents a flattened mass with an irregular, circular outline, thicker in the centre than at the periphery. The ventral surface is convex but quite uneven, due to the processes which project toward the skin. The thick central portion mentioned above is the corpus mammæ, and upon the size and extent of this the external conformation of the breast depends. The dorsal surface, as already noted, is flat or slightly concave and much less irregular than the ventral surface (Figs. 1044 and 1045).

The circumference is quite thick and well defined, but it is thicker below than above (Fig. 1044). When a section is made through the nipple, the cut surface of the corpus mammæ appears triangular. The apex of the triangle is at the nipple, and the base, which represents the dorsal surface, rests against the thorax, from which it is separated by the stratum of loose areolar tissue.

Extending from this central compact area of glandular tissue, the peripheral processes reach in all directions. As already noted, there are three main cusps: one extends cephalad toward and into the axilla; another caudad of the axilla; while the third reaches toward the sternum. Besides these large processes there are numerous small ones, which radiate in all directions around the circumference. These form numerous branched, interlacing processes enclosing and surrounding masses of fat.

From the ventral surface triangular processes project toward the skin (7, Figs. 1044 and 1045), and from the apex of the triangle the connective tissue covering the gland is prolonged to the dermis. In thin women the parenchyma at these points reaches almost to the surface.

From the dorsal surface, much more delicate processes project into the retromammary tissue, even reaching through this and extending into the pectoral fascia to get between the fibre bundles of the pectoralis major. These processes are very minute and are often overlooked.

Both body and processes are completely covered by a delicate connective tissue. Those parts of this which cover the scattered branched parts of the gland are continuous with the surrounding subcutaneous tissue. It is too delicate to be deserving of a separate name, but has nevertheless been called by some the fibrous capsule of the mammæ.

Stroma.—The stroma is tough and compact, but soft and yielding. It is white in color and is composed of coarse, wavy fibres. In the nullipara, there is only here and there an isolated fat lobule; consequently the fibres are closely arranged. In the multipara, much more fat is found in the stroma. Toward the periphery more fat lobules are seen, and the stroma of the peripheral processes becomes directly continuous with the connective-tissue framework of the fat lobules.

As stated above, from the apex of the processes on the ventral surface, the stroma is continued to the corium. These prolongations have received the name of ligaments of Cooper (7, Figs. 1044 and 1045).

Between the ventral processes of the gland, and therefore surrounded by the ligaments of Cooper, are supramammary accumulations of fat (adipose fossæ). On the dorsal surface of the gland are other fat spaces (retromammary fat) (9, Figs. 1044 and 1045). This is separated from the pectoral fascia by loose connective tissue, and in it one or more large lymph spaces are found, the retromammary or submammary bursæ. The subcutaneous fat and that between the lobules give the smoothness to the surface of the gland, and when it is absorbed, as during lactation or in emaciation, the lobules of the gland stand out much more distinctly.

Under the nipple and areola, the stroma contains no fat. Its fibres are here very loosely arranged, and allow free mobility of the nipple. It is this also which allows the distention of the ducts and sinuses during lactation.

Parenchyma.—The relative amount of parenchyma to the stroma varies in different nulliparæ, also even in the same breast one lobe or section may have numerous well-

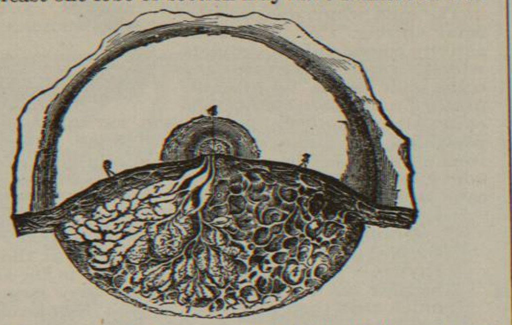

FIG. 1043.—Dissection of the Lower Half of the Female Mamma during the Period of Lactation. (Luschka.) *a, a, a*, Undissected part of the mamma; 1, the mammilla; 2, areola; 3, subcutaneous masses of fat; 5, three lactiferous ducts passing toward the mammilla where they open; 6, one of the sinuses or ampullæ; 7, some of the glandular lobules which have been unravelled; 7', others massed together. (Quain.)

developed lobules, while another has few or none, these remaining almost as at puberty merely branching ducts. The parenchyma, on close inspection of a cut surface of fresh gland, is seen to be made up of closely packed sago-like grains.

Ducts.—The ducts are also seen in a cross section, running through the nipple to its summit, where they open. Arising from the acini the minute ducts unite to form larger canals, so that each lobule gives rise to a single duct (lobular duct) (Fig. 1043). These join to form larger and larger ducts until but one duct leaves each lobe. This is known as the galactophorous or lactiferous duct. These, fifteen to twenty in number, corresponding to the lobes of the gland, gather at the nipple, through which they pass, in a vertical direction, to open upon its summit. Beneath the areola, each duct presents an irregular, fusiform swelling 12 to 15 mm. long and 6 to 8 mm. wide, known as the sinus or ampulla (Fig. 1043), also as the sacculus or reservoir. Secondary ampullæ occur here and there on the ducts. In the ampulla and the large ducts, milk accumulates in the intervals between nursing. Beyond the sinus, the ducts are reduced in size and collected into a bundle, the largest ones occupying the centre. Side by side, surrounded by muscle, areolar tissue, and vessels, and without communicating, they pass to the summit of the nipple. Here separately by minute orifices, they open into the bottom of depressions. The orifices, which measure 6 mm., are distinctly smaller than the ducts. In the loose areolar tissue under the areola, the ducts and sinuses receive minute ducts from the adjacent lobules.

The ducts are composed of two coats, an external and an internal. The external coat is formed of white fibrous tissue intermixed with longitudinal and circular elastic fibres. Smooth muscle fibres have also been described. They are said to be particularly abundant around the ampullæ, where they form an imperfect sheath. The inner coat is formed of epithelium resting on a basement membrane. The epithelial cells, constituting a single layer, are flat in the lobular ducts, becoming cubical in the larger ducts, and columnar in the lactiferous ducts and ampullæ.

Lobes, Lobules, and Acini.—Each of the fifteen to twenty ducts is the outlet for a single lobe of the gland. Each lobe is of a reddish cream color and rather friable, and is a compound tubo-racemose gland. Although each lobe is in contact on either side with the neighboring lobes, there is no known communication between them. The lobes are separated, by a considerable amount of areolar tissue, into lobules, which in turn are made up of acini (Fig. 1043).

The acini are small, spherical, or pyriform masses, measuring on an average 0,13 to 0.15 mm. in diameter. An acinus consists of a minute sac lined by a single layer of small granular epithelial cells (Fig. 1046 and 1047) resting on a delicate hyaline membrana propria. This latter completely envelops the acinus, and is continued for a short distance on the minute excretory duct, with which the acinus connects. The above is the condition in a gland which has not yet become active.

With the beginning of lactation an acinus enlarges, and becomes distended with a clear, slightly viscid yellowish secretion (Fig. 1047). Its cells are flattened against the membrana propria, and contain fat globules of varying sizes.

The fluid in the acini is the colostrum. It is produced for the first two to three days after delivery, when the

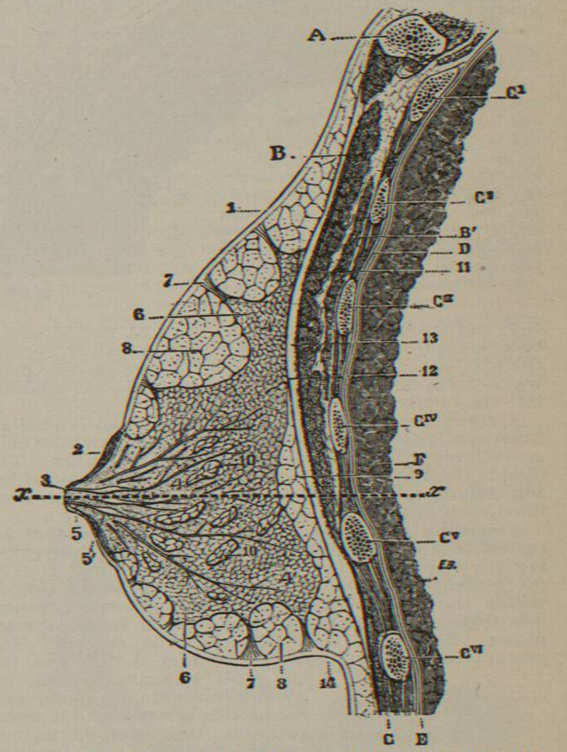

FIG. 1044.—Vertical Ventro-dorsal Frozen Section of the Right Breast of a Woman, Twenty-two Years Old. C¹-C⁶, First to sixth ribs; A, clavicle; B, pectoralis major; B', pectoralis minor; C, external oblique; D, intercostals; E, pleura; F, lungs; 1, skin of breast; 2, areola; 3, nipple; 4, mammary gland, central part; 4', peripheral part; 5, milk ducts; 5', sinus; 6, cusps of the mammary gland; 7, ligaments of Cooper, continued to the skin; 8, fat lobules; 9, fatty retromammary pad; 10, intramammary fat; 11, aponeurosis of pectoralis major; 12, superficial fascia forming suspensory ligament of breast; 13, layer of loose areolar tissue between superficial fascia and subjacent serous aponeurosis of the breast; 14, submammary furrow. (Testut.)

free secretion of milk is first established. Besides serous fluid, colostrum is composed of fat globules of varying size, similar to those found in normal milk but somewhat larger and having a tendency to agglutination; also of granular cells, spherical or oval in shape, having a diameter or from 3 to 25 μ (colostrum corpuscles). The corpuscles consist of a mass of fat globules surrounded by protoplasm.

By some these are considered to be fatty-degenerated leucocytes, by others the central cells of the originally solid acini, also fatty-degenerated. The subject has led to much controversy and is by no means settled.

When fully active the acini secrete true milk. The protoplasm in the cells becomes broken up and displaced toward the outside by the accumulation of oil drops (Fig.

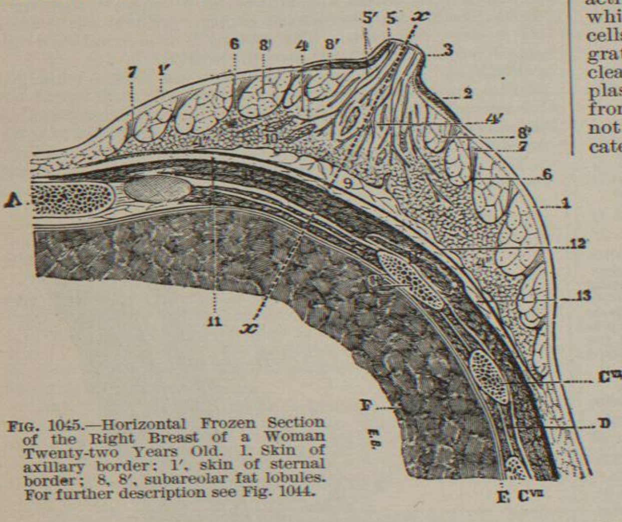

FIG. 1045.—Horizontal Frozen Section of the Right Breast of a Woman Twenty-two Years Old. 1. Skin of axillary border; 1′, skin of sternal border; 8, 8′, subareolar fat lobules. For further description see Fig. 1044.

1048 and 1050). The minute oil drops, at first separate, become confluent, forming larger globules which occupy the greater part of the entire cell. There are two main ways of explaining the liberation of these oil globules into the lumen of the acini.

According to the first, the mammary gland is similar, functionally, to a sebaceous gland. The glandular cells are believed to multiply constantly during lactation. The cells in the deeper layer replace, toward the lumen of the acini, those in a superficial layer, and these becoming filled with fat globules degenerate and break down.

According to the second, the fat globules as they accumulate in the cell force the nucleus with its surrounding protoplasm against the basement membrane. The fat globules continue to accumulate until the tension within the cell is so great that its membrane ruptures into the acinus, liberating the superficial fat and protoplasm. But the cell itself is not, as a rule, cast off. The protoplasm accumulates again around the nucleus, the cell wall is again formed, fat globules accumulate again and the process is repeated. It seems probable that after numerous repetitions the cell becomes worn out and is cast off, to be replaced by a new cell.

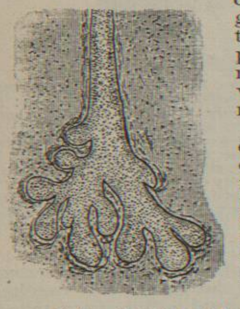

FIG. 1046.—Terminal Branches of a Milk Duct from the Breast of a Young Woman. (Bardeleben, × 56.)

Within an acinus the cells are cubical, or even columnar and of very unequal size. Some are found large, distended with fat projecting into the lumen, others small, consisting merely of a nucleus and so little fat that it is obscured by the protoplasm. Between these are all grades.

During lactation the acini have a comparatively wide lumen, the epithelial layer forming but a thin lining to the irregular tubular or spherical spaces.

At all times there are numbers of mast cells in the connective tissue surrounding the lobules. During lactation these are immensely increased. They have been supposed to have some connection with the secretion of the milk, but their exact function is not yet known.

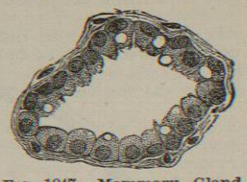

FIG. 1047.—Mammary Gland of the Dog. Transverse section of a terminal vesicle, showing an early stage of the formation of fat globules. (Heidenhain.)

The milk which distends the acini during full functional activity consists of fat droplets which were present in the cells, and débris of disintegrated protoplasm floating in a clear albuminous fluid (milk plasma). The milk globules from 2 to 5 μ in diameter do not coalesce owing to a delicate sheath of casein, Acherson's membrane.

During pregnancy and lactation, the increase in the size of the gland is due to increase of the parenchyma. This consists of an increase in the size and number of the lobules. Finally they increase so much that they touch and cause a disappearance of fat between them. At this time on section the naked-eye appearance closely resembles that of a salivary gland. Moreover, at this time the superficial fat becomes absorbed, and the vessels become dilated and their walls thickened. The breast, due to the rapidly growing acini, presents to the hand an uneven feeling. The acini increase first on the peripheral processess, thence along the larger ducts toward the centre of the corpus mammæ.

After lactation the breast returns to a resting stage. The parenchyma undergoes involution, and fat is developed in the stroma. The acini are reduced to narrow tubules, many becoming atrophied. The gland does not regain its virgin appearance; therefore it is easy to tell an involuted multiparous from a nulliparous breast. The corpus mammæ is loose, irregularly broken up, and less distinct. The peripheral processes are larger, with a more extensive distribution. It is therefore easy to separate the corpus mammæ from them. The stroma is loose, and contains numerous fat lobules. The whole is less smooth, firm, and elastic; therefore it tends to be pendulous, and a sulcus is formed where it overhangs its base. With each succeeding pregnancy a new period of activity is followed by involution.

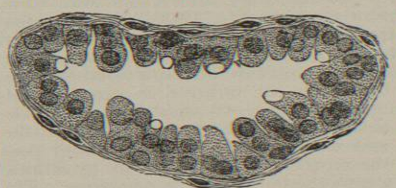

FIG. 1048.—The same Anatomical Relations as are shown in Fig. 1047. The gland, however, is in its highest stage of functional activity. (Heidenhain.)

With the end of the sexual activity a gradual permanent atrophy of the secreting portion of the gland begins. This occurs, according to Stiles, by a fatty degeneration of the epithelium followed by its absorption. The atrophy is more or less complete and may leave only the ducts. In thin women, the corpus mammæ is represented, after the menopause, by a flattened disc closely related to the skin, and also to the underlying pectoral muscle. The peripheral processes can scarcely be separated from the body, and are reduced to mere irregular threads. In fat women after the menopause the breast remains of a large size, but is composed almost entirely of fat. A few ducts, here and there, form a wide meshwork except in the neighborhood of the nipple, where there is a flattened disc of gland tissue.

The skin covering the ventral surface of the breast, except at its centre, does not differ from that of the adjacent thorax. It is thin, flexible, and very adherent to the subjacent fatty tissue and covered with minute hairs

and rudimentary sebaceous glands. Following pregnancy the skin is sometimes marked with bluish or whitish striæ similar to those of the abdomen.

In the centre of this skin is the areola surmounted by the nipple. The skin of the areola is thinner and more delicate than that surrounding it (Fig. 1051, A). It is pigmented and marked by numerous well-developed sebaceous glands. Its under surface is devoid of fat, but contains numerous unstriped muscle fibres. The areola

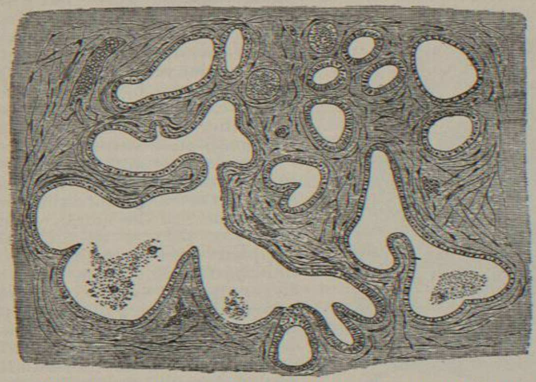

FIG. 1049.—From a Cross Section of the Corpus Mammæ of a Woman who Died during Childbirth, showing the Cubical Epithelium of the Tubules. (Bardeleben, × 116.)

measures 15×35 mm. in diameter. Its color in nulliparæ is a rosy pink, whose shade differs with the complexion of the individual.

In the second month of pregnancy the areola begins to enlarge and darken. This increases as pregnancy advances and serves as one of the signs of gestation. After lactation the color fades, but seldom entirely disappears. In dark brunettes, during pregnancy, the pigmentation becomes very dark, almost black, and following lactation considerable pigment remains. In light blondes, on the other hand, the darkening of the areola is very slight and may subsequently almost entirely disappear. In the fifth or sixth month of pregnancy there is sometimes seen around the areola an irregular slightly pigmented ring, the secondary areola (Fig. 1051, B).

The ventral surface of the areola is roughened by numerous slight elevations. These are caused by well-developed sebaceous glands, areolar glands. At the centre of each a minute lanugo hair marks its opening. During pregnancy these glands enlarge markedly, forming hemispherical elevations from 2 to 5 mm. in diameter. They are now known as the tubercles of Montgomery (Fig. 1051). They are particularly numerous and well marked in the secondary areola (Fig. 1051, B). Toward the end of gestation they become very active, their peculiar fatty secretion keeping the areola moist and serving to protect it during suckling.

The sudoriferous glands of the areola are remarkable for their large size and degree of convolution.

Besides the above there are from five to fifteen accessory milk glands below the areola. They vary considerably in size, and open on the summit of the nipple. The areolar muscle proper is thickest beneath the nipple and fades toward the circumference of the areola (Fig. 1044). It is composed mostly of circular fibres among which are mixed certain radially disposed bundles. All are attached to the skin, making it therefore a skin muscle analogous to the dartos.

The Nipple.—The nipple is situated a little meso-caudad of the centre of the breast on a level with the fourth rib or over the fourth intercostal space and about 12 cm. from the midline (Figs. 1044 and 1045). Developed from the gland area, in the third year it projects from the surface, and soon becomes conical or cylindrical. It attains its full size shortly after puberty. In some cases it is hemispherical, flattened, or discoidal, or with apex larger than base, pedunculated. It is about 10 to 12 mm. long, with a diameter at the base of 9 to 15 mm., and points ventrad and slightly laterocephalad. Its tip is rounded and marked by fifteen to twenty minute depressions, milk pores, into which the lactiferous ducts open. These form the cribriform area. In some cases the nipple is retracted into a depression and projects only on response to stimuli. The skin of the nipple (Fig. 1051, 1), thin and pigmented like the areola, is remarkable for the number and size of its papillæ. It possesses neither hair follicles nor sweat glands, but near the base are a number of sebaceous glands.

The muscle fibres of the areola are continued up into the nipple, being separated from the skin below only by the sebaceous glands. They form a layer composed almost exclusively of circular fibres. From the inner side of this layer numerous muscle bundles are given off. These cross and recross and form a sort of trellis around the lactiferous ducts. Under the influence of cold, emotion, or touch these contract, causing circular folds in the skin of the areola, and causing the nipple to become firmer and more projecting. Besides causing this erection of the nipple, the rhythmical contraction of the fibres tends to force the milk from the distended milk ducts and sinuses into the area cribrosa. If the fibres contract spasmodically, they act as a sphincter and retain the milk. Another set of fibres take their origin from the deep connective tissue below the nipple and end upon the under surface of its skin. They pass in variously-sized bundles through the connective tissue which surrounds the milk ducts. Contraction of these fibres causes the nipple to retract.

During pregnancy the nipple becomes larger, more readily erectile, and more sensitive. Suppression and multiplication of the areola and nipple were considered with suppression and multiplication of the gland proper.

Arteries.—The arteries which supply the breast are derived from three sources: from the internal mammary, from the lateral thoracic (long thoracic), and from the intercostal. The internal mammary, a branch of the subclavian, is the principal artery of the breast. It gives off

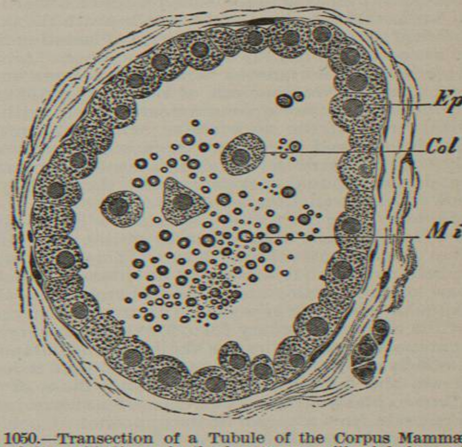

FIG. 1050.—Transection of a Tubule of the Corpus Mammæ. *Ep*, Glandular epithelium; in the lumen are milk globules and colostrum corpuscles. (Bardeleben, × 400.)

two or three branches (rami perforantes), which pierce the chest wall and then pass to the cephalo-mesal edge of the gland, where they break into branches for both of its surfaces. The lateral thoracic, a branch of the axillary, gives two or three branches (external mammary rami) to the external portion of the breast. Besides the above, twigs from the pectoral rami of the acromial thoracic artery pierce the major pectoral and supply the cephalic segment of the breast. Lastly, the intercostal furnishes several small, short branches to the caudal segment and posterior surface. The above vessels, taking a sinuous course, break up into numerous branches which anastomose freely and ramify in the fascia surrounding the gland. From the wide-meshed, irregular network of the ventral surface two sets of branches are given off: one very small to the skin, the other much larger to the gland proper. These latter, situated in the stroma, divide and subdivide on the connective-tissue framework.

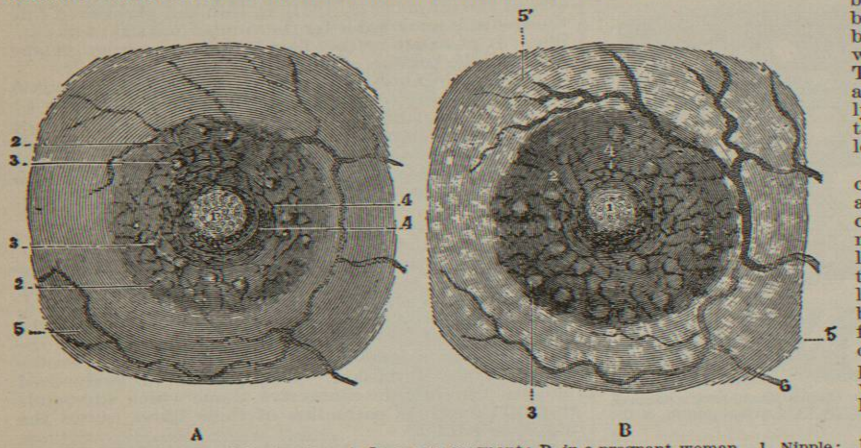

FIG. 1051.—The Nipple and its Areola. A, In a non-pregnant; B, in a pregnant woman. 1, Nipple; 2, areola; 3, tubercle of Montgomery; 4, sulcus at the base of the nipple; 5, skin of breast; 5', secondary areola; 6, venous circle of Haller.

They finally form a close capillary network which surrounds the acini. The arterioles of the nipple do not form cavernous sinuses, and its erection is due entirely to the muscular tissue.

Veins.—From the arterial capillary plexus around the acini a venous plexus arises. This proceeds toward the ventral surface of the gland and forms beneath the skin a large-meshed plexus. During the period of lactation these vessels are seen through the skin as blue lines. Around the nipple, these subcutaneous veins form a more or less complete ring, the venous circle of Haller (Fig. 1051, B).

The superficial network communicates freely with the superficial veins of the neck above, with those of the abdomen below, and with the thoraco-epigastric vein laterally. These carry the blood into the subclavian, the intercostal, the internal mammary, and the axillary by branches which parallel the arteries.

Lymphatics.—The following description of the lymphatics is in the main that given by Stiles, and differs somewhat from that of other authors. There are five sets of lymphatic vessels: (1) superficial or cutaneous, including those of the nipple, areola, and surrounding skin; (2) subareolar plexus (Sappey); (3) intramammary; (4) those of the circummammary fat; (5) retromammary.

The cutaneous lymphatics are similar to the cutaneous lymph vessels elsewhere. It is to be noted that those of one side of the body communicate with those of the other; thus explaining the occurrence of axillary infection on one side from a tumor of the opposite. Upon the skin of the nipple and areola the network formed by these vessels is very close, being particularly rich upon the nipple. They open mainly into the subareolar group.

The subareolar lymphatics consist of very large vessels, forming a wide-meshed network running horizontally in the loose areolar tissue around the lacteal sinuses. As noted above, the cutaneous vessels open into this plexus, as do also many of the intramammary vessels. It thus serves as a means of communication between the two. From the subareolar plexus of lymphatics Sappey states that there are two and sometimes three large trunks which open into the axillary lymph nodes.

The intermammary lymphatics begin as a plexus of small channels consisting of a single layer of endothelium supported by stroma. Each mesh of the network surrounds one or more of the ultimate lobules of the gland, and receives its lymph from the interacinous spaces. From this layer vessels parallel to the milk ducts proceed to the subareolar plexus into which they empty.

These periductal as well as the perilobular lymphatics anastomose with others which are closely related to the blood-vessels. The larger blood-vessels are accompanied by two or more lymphatics which occupy their sheaths. The smaller vessels are usually accompanied by only one lymph channel, which is larger than the vessel and more or less completely surrounds it.

The circummammary set receives branches from the skin and the ventral surface and circumference of the breast. It is merely a part of the general lymphatic system of the ventral chest wall. From this set larger lymph vessels proceed between the layers of the deep fascia. They soon pierce the deep layer of this fascia and proceed, as large muscular-walled lymph vessels, to the lymph glands.

The retromammary lymphatics include those of the pectoral fascia. They receive branches from the posterior surface of the gland. Either directly or indirectly some of the lymph from all other sets passes into these lymphatics of the deep fascia which accompany the mammary blood-vessels and thus reach the lymph nodes.

The lymphatics of the inner part of the gland accompany the branches of the internal mammary artery through the chest wall and empty into the sternal lymph nodes situated along this artery. A great many accompany the branches of the axillary artery to empty into the axillary lymph nodes. The retromammary lymphatics of the two breasts communicate.

During the activity of the breast the lymphatics are filled and the lymph nodes are red, solid, and composed almost entirely of lymphoid tissue. During inactivity the lymph vessels are but slightly filled and the nodes appear to take on a fatty change. This is particularly marked in senility.

Nerves.—The nerves of the breast, excluding those derived from the sympathetic, which enter the gland with the arteries, are derived from three sources: first, from the second, third, fourth, fifth, and sixth intercostals; second, from the cervical plexus; third, from branches of the brachial plexus. The intercostals supply the breast by twigs from their anterior and lateral cutaneous branches. The third and fourth cervical nerves of the cervical plexus give off the suprasternal, supraclavicular, and supra-acromial. Twigs from the middle of these groups, the supraclavicular, supply the upper part of the breast. From the inner and outer cords of the brachial plexus the internal and external anterior thoracic nerves take origin and pass forward to supply the pectoralis major and minor muscles. Twigs from these nerves pierce these muscles to supply the breast on its under surface. These nerves receive their fibres from the anterior primary divisions of the sixth, seventh, and eighth cervical and first thoracic nerves. They proceed to the gland proper, to the skin, to the muscle fibres below the areola as well as to the blood-vessels. On and around the areola some of the nerves end in Pacinian corpuscles, and in the nipple they may end in tactile corpuscles in the papillæ.

Stimulation of the mammary nerves causes an erection

of the nipple, dilatation of the vessels, and secretion of milk. After section of the cerebro-spinal nerves erection of the nipple does not occur, but the secretion of milk is not interfered with. It seems probable that there are special nerves, aside from those of the blood-vessels, governing secretion; but this has not been proved. Emotional disturbances (anger, fear, and so forth) arrest secretion.

From 500 to 1,500 c.c. of milk is daily secreted. To remove this from the gland there is not only the mechanical action of sucking, but also the activity of the gland itself. This latter consists in the contraction of the muscle fibres beneath the areola. By these the nipple is erected and by their rhythmical contraction the milk ducts and sinuses are emptied. The sucking not only stimulates the muscle to act, but also excites the sensory nerves of the nipple, thus causing a reflex stimulation of the gland acini and an increase of the secretion. During activity the vessels of the gland are dilated. The amount of the secretion appears to be influenced by blood pressure. Frequent and rapid emptying of the gland causes a greater flow, possibly through secretion pressure within the cells. The oftener the breasts are emptied the richer the milk becomes in casein. The last milk obtained at any time is always richer in fat, as it comes from the acini.

Human milk is always alkaline. Cow's milk may be alkaline, acid, or neutral. The milk of carnivora is always slightly acid. Various substances, when eaten by the mother, are secreted in the milk. Such are anise, vermouth, garlic, etc.; chloral, rhubarb, opium, iodine, mercury, lead, etc. Some substances, such as atropine, arrest the secretion of milk.

Milk contains large amounts of casein, lactose, and fat, also certain inorganic constituents. Neither the casein nor the lactose occurs in the blood, and fat is found only in small amounts. The inorganic salts in the milk are in different proportions from those found in the blood. Food rich in proteids increases the amount of milk, but the relative amount of fat is increased more than the other constituents. With a pure flesh diet, the milk contains a very large amount of fat. Fat added to the food, if not accompanied by an addition of proteid material, rather diminishes than increases the amount of fat in the milk. It appears, therefore, that the fat in the milk is not obtained from the fat taken with the food, but is the result of the decomposition of the proteid. Increasing the carbohydrates of the food does not increase the amount of sugar in the milk. The greatest part of the sugar is therefore also derived from the proteids; so too is the casein. Both the milk sugar and the casein are probably formed by the action of ferments which remain in the cells and do not pass into the milk. It is clear that milk is a chemical product, and that it is due to the activity of the cells in the mammary gland. Concerning the specific chemical source of the constituents, nothing is known with certainty. The relative proportion of the various constituents of the milk varies in the different months after delivery. The cause of this variation is not known, but by it those substances best suited to the child during its different periods of growth seem to be supplied.

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For good bibliographies, consult Quain, Testut, von Bardeleben, Henle, Henneberg, and Profé.

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BREAST, FEMALE, DISEASES OF THE.—AMAZIA.—Entire absence of mammary glands is extremely rare, and is accompanied by other deformities usually incompatible with life. Absence of one breast is more often met with, and the corresponding ovary is found to be wanting as well (Scanzoni), or the great pectoral muscle of the same side. Probably absence of one breast and deformity of the other is the nearest approach to amazia found in the adult. A rudimentary breast may be so small as to justify the term micromazia.

POLYMASTIA.—Supernumerary mammæ are not uncommon. Bruce,[1] in 4,000 examinations, found this deformity present in 1.54 per cent., a ratio greater than usual, I believe. He also finds men more often affected than women, in the proportion of 4 to 1, a result contrary to that obtained by Godfrain.[2] I have seen the deformity more often in females. Axillary prolongations are not infrequently met with, and may be mistaken for lymphatics. They undergo the usual development during pregnancy, the secretion escaping by the nipple. Supernumerary mammæ occur most frequently in pairs, and are situated below the normal glands, rather nearer to the middle line of the body; the situation next in frequency is above the normal glands and further from the middle line, *i.e.*, toward the axilla. When the deformity is unilateral, the left side is most often chosen. Supernumerary glands below the normal mammæ are larger and better supplied with nipple and areola than when situated on the side toward the axilla. They of course follow the evolution of the natural gland, becoming most apparent during lactation, and undergoing atrophy after the menopause. Klob has recorded an additional mamma, on the shoulder, the size of a nut; it was provided with a nipple. Two examples have been noticed on the back. Robert reports an instance upon the thigh; Percy, one upon the epigastrium. Multimammæ are not over fecund, and may or may not be provided with nipples for the additional glands, or the secretion may escape by a small opening. Functionally also there may be great variation. Ross[3] reports a mulatto with a third breast beneath the normal left one. It was six inches in circumference, was provided with nipple, follicles, and areola, yielded milk, and if not attended to was painful from overdistention. The nipple was too small for the child to nurse. Lynceus[4] reports a woman with four breasts in two vertical lines. All gave milk abundantly. Gardner[5] mentions a similar case in a negress, the supernumerary glands being in the neighborhood of the axillæ. Percy[6] reports the case of a vivandière who had four mammæ in two vertical lines, and a fifth five inches above the umbilicus, in the middle line. This latter resembled the breast of an impubic girl; the other four secreted milk.

Alexander[7] records the case of a mulatto male with six nipples in two vertical lines, there being a distance of four inches between the nipples vertically. The subject of the report stated that his mother was malformed in like manner, four of her nipples giving issue to milk;