merary nipples seem to be more frequently developed in men than in women; accessory true glands, however, are much more often found in female subjects than in male. The most common situations for the additional nipples are below the position of the normal glands, somewhat nearer the midline; they may occur on one or on both sides, more often, however, on the left side. Other locations of the aberrant nipples generally follow a line passing from the axilla toward the groin; exceptionally they may be upon the back or outer surface of the thigh.

The existence of supernumerary mammary glands is much rarer than of the nipples and is more frequent in women than in men. The positions of such mammæ observed in women include the back, shoulder, axilla, thorax, abdomen, groin, labium majus, and thigh. Trustworthy records show that such organs secreting milk have been located in the axilla, on the chest and the abdomen, in the groin, and on the external surface of the thigh. Hirst[144] refers to a negress of nineteen years who possessed nine mammary glands, five on one side and four on the other. Two of the accessory organs were small and did not secrete; all the others gave milk in large quantities.

The investigations of O. Schultze[145] have shown that the mammary glands are developed along the *milk lines*, ridges of thickened epithelium extending from the dorsal surface, in the vicinity of the fore limbs, ventrally to end in the inguinal region. These observations at once point out the correspondence between the location of the majority of supernumerary nipples and milk glands and the normal formation tracts, the excessive mammæ of the human subject marking unusual development of possible anlages which ordinarily remain quiescent. The influence of heredity seems to be uncertain, although in a number of reported cases both mother and daughter presented polymastia, although the location of the supernumerary mammæ was not identical.

George A. Piersol.

Literature.

The enormous and ever-increasing volume of the literature relating to malformations forbids any attempt to present systematically in these pages even a synopsis of teratological bibliography. Fortunately this is also unnecessary, since those especially interested will find a practically complete bibliography since 1886 in the Anatomischer Anzeiger and the Centralblatt für allgemeine Pathologie, as well as in Schwalbe's "Jahresberichte der Anatomie u. Entwicklungsgeschichte." The "Reports on Teratological Literature" by Windle, which appear from time to time in the Journal of Anatomy and Physiology, are also useful. A valuable general bibliography, including the most important papers, is appended to Marchand's article "Missbildungen" in Eulenburg's "Real-Encyclopädie." For the older literature the reader can consult with advantage Förster, "Die Missbildungen des Menschen," 1861, and Ahlfeld, "Die Missbildungen des Menschen," 1880. A comprehensive list of journal references and monographs, appearing between 1880 and 1901, will be found in Hirst and Piersol's "Human Monstrosities."

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TERATOMA.—A teratoma is a tumor-like growth characterized essentially by the fact that the tissue-formation of which it is composed does not occur normally in the affected region, or at least not during that period of bodily development in which it presents itself. Such a growth may consist of a single tissue, or may be represented by a cyst (*simple teratoid tumor* or *cyst*); but more frequently it is made of several tissues arising from more than one of the germ layers (*mixed tumor*, "*Mischgeschwulst*"). To the more complicated forms the term teratoma is often applied in a more narrow sense, while those highly complex growths which contain tissues derived from all three of the germ layers are known as *embryoid tumors* or *embryomata*. Teratomata composed of tissue-formations which are out of place in the region where found are known as *heterotopous;* those composed of tissue occurring in a given region at a time when it should not normally be found there are known as *heterochronous*. The tissue-formation composing the teratoma takes its origin either from the anlage of the individual affected (*monogerminal*, *endogenous*, or *autochthonous teratoma*), or from the anlage of a second individual (*bigerminal* or *ectogenous teratoma*, *fœtus in fœtu*). Further, either a sarcomatous or a carcinomatous proliferation may develop within a teratoma, and the growth thereby assume the characteristics of a malignant tumor (*malignant teratoma*).

According to their structure, teratomata may be divided into the following varieties:

Teratomata.
- 1. Simple teratoid tumors.
- 2. Simple teratoid cysts.
  - Ectodermal.
    - Dermoid.
    - Epidermoid.
  - Mesodermal.
  - Entodermal.
- 3. Complex teratomata and teratoid cysts (embryoid tumors and embryomata).
- 4. Malignant teratomata.

I. Simple Teratoid Tumors.—In this class are placed both heterotopous and heterochronous tissue-formations of simple structure, consisting of but a single variety of tissue, or at most of but a few forms of tissue. For the greater part they consist of heterotopous tissue-proliferations which have their origin in misplaced or persistent fœtal anlage. They may occur in any part of the body, but are found most frequently in certain regions. The most common tumors of this class are the hypernephroma (*kidney, kidney region, liver, etc.*), rhabdomyoma or rhabdomyosarcoma (*kidney, testicles, vas deferens, heart, va-*

gina, cervix, bladder, etc.), chondroma (*salivary glands, mamma, skin, testicles*, etc.), chondromyxoma (*salivary and lachrymal glands, mammæ, testicles*), adenomyxoma (*mamma*), adenosarcoma (*kidney*), adenomyoma (*uterus, broad ligament*), leiomyoma (*kidney*), osteoma (*muscles, skin, mamma*, etc.), lipoma (*meninges*), and the tumor-like formations found along the vertebral column (*coccygeal and lumbosacral lipomata, myolipoma, and the tumors of this region which contain nervous elements*).

The occurrence of tissue-formations in regions in which such tissue-elements are not normally found may be explained by the assumption of a misplacement of tissue anlage, or of tissue at a later stage of development, or of the persistence of undifferentiated cells, which possess the power of producing different forms of tissue. In general, it may be said that the simple teratoid tumors correspond in their structure with the tissue-differentiations occurring normally in the region in which they arise. Every part of the body practically has its corresponding mixed tumor, which in its structure harmonizes with the normal differentiation of the tissues and organs of that region. Thus, for example, the mixed tumors of the salivary and lachrymal glands contain cartilage, bone, myxomatous tissue, connective tissue, epidermis, and glandular tissue, corresponding to their origin from ectodermal and mesenchymal anlage of the head or mouth region. In the mixed tumors of the mamma myxomatous tissue, cartilage, epidermis, and gland tissue are found, corresponding to their origin from ectodermal and mesenchymal or mesodermal anlage. The mixed tumors of the kidney and kidney region which contain striped muscle, cartilage, etc., arise from anlage of the myotome and middle plate. Those of the vagina and cervix arise from the anlage derived from the myotome and sclerotome, or from that portion of the mesoderm lying posterior to the kidney. It is probable that the teratoid growths of this region are dependent upon the development of the Wolffian duct, as they are situated for the greater part in the region of the ducts of Gärtner. The fatty tumors containing epithelial and nervous structures, which are found along the spinal column, chiefly in the lumbo-sacral and coccygeal regions, are due to misplacements of anlage or tissue caused by defective development of the vertebral arches, and are to be classed with the various forms of the malformation known as *spina bifida occulta*. Similar tumors are also found in the cranium. In the changes following a hernial protrusion of the spinal cord and meninges in spina bifida both adipose tissue and striped muscle may be misplaced into the spinal canal. Transposition of adipose tissue, muscle, cartilage, ependymal tissue, and neuroglia is not infrequently seen in these malformations. The lipomata of the cerebral meninges are likewise to be explained in part as due to a transposition of adipose tissue following or attendant upon a defective development of the cranium.

Though the great majority of the simple teratoid tumors are to be regarded as heterotopous proliferations of tissue arising from autochthonous fœtal anlage, it is also possible that some may be due to bigerminal inclusions, in which only one or but a few of the tissues of the parasitic twin persist. The parent cells of the simple teratoid growths in either case remain latent or grow slowly until through some exciting factor a more active proliferation is set up. At first the misplaced anlage increases through a proliferation of undifferentiated cells, but with changing conditions of growth a portion of the cells becomes differentiated, and there are formed mature tissues, which may continue to proliferate in their differentiated form. The causes of active proliferation of latent anlage are unknown; inflammation or irritation or atrophy of the affected part may play the rôle of exciting factor. That the early stages of growth consist in the formation of undifferentiated cells is shown by the fact that the younger portions of the tumor are always composed of such cells. These may predominate to such an extent that the growth resembles a sarcoma (adenosarcoma, rhabdomyosarcoma). Further, the fact that the different tissues constituting the growth (cartilage, striped muscle, etc.) occur in all parts of the tumor can be explained only by the assumption of a later differentiation of cells arising through the proliferation of the undifferentiated cells of the misplaced or persistent anlage. Moreover, the fact that the metastases of the mixed tumors may contain all the tissue found in the primary points to the metastasis of undifferentiated cells, which later become differentiated.

The simple teratoid tumors of the salivary glands, mamma, kidney, uterus, etc., though placed in the same tumor class because of their analogous origin from cells of the ectoderm, mesenchym or mesoderm, nevertheless show great differences in their manner of growth, malignancy, etc. The mixed tumors of the parotid are very slow in development, they produce no metastases, and are relatively benign in character; those of the kidney, uterus, and vagina may grow very rapidly, set up metastases, and assume the character of very malignant tumors. The metastases arise from the transportation of undifferentiated cells from the primary tumor; through the differentiation of these the daughter tumor comes to contain the same tissues as the parent tumor. However, a metastasis of more highly differentiated cells may occur, and the tumor arising from these may present a less complicated structure than the primary. The metastases of the mixed tumors, like those of sarcoma, are hæmatogenous, the lymph glands being rarely involved. The differences in malignancy between the mixed tumors of the salivary glands and those of the kidney cannot at present be explained. The latter present the clinical characteristics of sarcoma, occur more frequently in early life, grow rapidly, and are usually fatal; the former develop in later life, grow slowly, and are only rarely fatal. A secondary carcinomatous or sarcomatous proliferation may, however, develop within the benign teratoid growths of the lachrymal and salivary glands, mamma, etc. The hypernephroma is also frequently the seat of a proliferation so active as to assume clinically the characteristics of malignancy.

All the teratoid tumors are to be regarded as congenital tumors, even when developing very late in life. The persistence of undifferentiated anlage in a latent condition for years has physiological analogues in the late development of the beard, pubic hair, wisdom teeth, etc. Nevertheless, many authors do not accept the congenital origin of these growths and assign to them a development from endothelium, or explain their mixed structure as arising from a metaplasia of other tissues, some going so far as to assume a metaplasia of unstriped muscle into striped, or even of connective tissue into smooth muscle. In some of the simple teratoid tumors, particularly those of the salivary and lachrymal glands, the proliferation of the endothelium is often the predominating feature of the growth, and from a purely structural point of view justifies the designation of *endothelioma* or *myxochondroma endotheliale*, as the case may be. In the consideration of these growths it must be borne in mind, however, that the proliferating endothelium arises from the tumor anlage, and not from the endothelium proper of the region concerned.

2. Simple Teratoid Cysts.—The simple teratoid cysts may be divided into three classes: the *ectodermal, mesodermal*, and *entodermal cysts*.

(*a*) *Ectodermal Cysts.*—These arise from the misplacement or transplantation of ectodermal anlage. They may consist of cavities lined only by stratified squamous epithelium, without hairs or other skin structures (*epidermoid cysts, epidermoids*), or of cysts whose walls contain hairs, glands, subcutaneous fat, etc., presenting all the characteristics of skin (*dermoid cysts, dermoids, dermatocysts*). In the case of the former only epidermal anlages are transplanted; in the case of the latter, embryonal dermal tissue must also be transplanted. These growths are of frequent occurrence; they vary in size from that of a pea to that of an orange. Both epidermoids and dermoids occur chiefly in the skin and subcutaneous tissues as cysts filled with a pultaceous material, resembling atheromata or sebaceous cysts caused by retention of the secretion of sebaceous glands. In the epidermoids the cyst contents consist of desquamated horny cells alone; in the dermoids hairs are found in addition to the desquamated cells. The hairs are of a light or reddish color. Fatty degeneration or liquefaction of the cyst contents may occur, and cholesterin plates may be present in large numbers. At other times the contents are firmer, dry, and present a pearly translucency or lustre. The cyst contents may also become calcified.

Epidermoids.—These are found most frequently in the cranium, neck, thoracic cavity, mediastinum, pelvic cellular tissue, coccygeal region, and perineum, and more rarely in the peritoneal cavity. In the cranium they occur in the meninges or in the hypophysis in the form of the tumors known as *cholesteatomata* or *pearl tumors*. These are spherical or nodular tumors, varying in size from that of a pea to that of an orange, and are distinguished by their glistening satiny white surface. Microscopically, they consist chiefly of thin, non-nucleated, scale-like cells arranged in closely packed laminæ, the central portions of which may present a pultaceous disintegration and enclose plates of cholesterin. According to Boström they are invariably situated at some point upon the pia, which at the site of the growth is covered with stratified squamous cells. These become piled up into a tumor-like mass, and in the course of years form the horny laminæ, which constitute the growth. The neighboring brain tissue and the arachnoid are not concerned in the formation of the horny cells. The dura and arachnoid may cover the tumor. Portions of the cholesteatoma may become separated from the main mass and be misplaced into the brain tissue. At the base of the brain cholesteatomata may be found in the neighborhood of the olfactory lobe, tuber cinereum, corpus callosum, pons, medulla oblongata, cerebellum, and choroid plexus. They are seen but rarely in the meninges of the spinal cord. The intracranial epidermoids arise most probably from epidermal germs which have become misplaced into the anlage of the pia at a very early stage of development. According to Boström, this takes place in the time between the closure of the medullary canal and the separation of the secondary vesicle of the fore-brain from the fore-brain or tween-brain, and the separation of the after-brain vesicle from the hind-brain (fourth to fifth week). The mediastinal dermoids probably arise from disturbances of development of the thymus. Those occurring in the neck arise from remains either of the branchial clefts or of the ductus thyreoglossus. The cholesteatomata of the middle ear may in part be explained as due to misplaced epidermal germs. The epidermoids of the pelvic cellular tissue are the result of epithelial inshoots from the perineum.

Dermoids.—The simple dermoid cysts or dermoids possess walls showing all the characteristics of skin—that is, papillæ, hair follicles, hairs, sweat, and sebaceous glands, and often also subcutaneous fat. The cyst contents are similar to those of the epidermoids, but contain in addition hairs. The dermoids are found in the same regions as the epidermoids, and are to be explained as due to transplantations of dermal anlage at the same time as epidermal.

Both the epidermoids and dermoids may be the seat of development of a squamous-celled cancer. This event occurs most frequently in the neck region (branchiogenic and subcutaneous carcinoma).

(*b*) *Mesodermal and Entodermal Cysts.*—Cysts arising from misplaced or persistent entodermal or mesodermal anlage are of relatively frequent occurrence. They are characterized by a lining of columnar cells, which are often ciliated; and they form cysts varying in size from that of a pinhead to that of a man's head. They are found most frequently in the broad ligament and tubes, less often in the peritoneal cavity, intestine, in the neighborhood of the trachea and bronchi, in the lungs, pleura, tongue, neck, liver, kidneys, etc. They owe their origin to the persistence of fœtal glands or ducts, or to misplaced entodermal or mesodermal epithelial anlage. Those found in the uterine wall, broad ligament, and tubes arise from remains of the Wolffian body and the duct of Gärtner; those of the cervix, portio vaginalis, vagina, and hymen arise from remains of the latter. In the peritoneal cavity and abdominal wall they may arise from snared-off and persistent portions of the intestine (*enterocysts*), or from portions of the urachus (*urachus cysts*). In the liver and kidney they may arise from portions of the gland tubules, which become constricted during the period of development (*adenocysts*). In the neck remains of the internal branchial clefts, in the posterior portion of the tongue the remains of the thyreoglossal duct, or of epithelial buds and glands developing from the same, in the œsophagus and respiratory tract snared-off portions of the intestinal canal or air passages, or remains of the communication between the alimentary tract and air passages, may form the anlage for the development of such cysts. Cysts lined with columnar cells may arise in the central nervous system or its immediate neighborhood (*myelocysts*). These are seen most frequently in the lumbosacral and coccygeal regions. In the abdominal wall cysts lined with columnar cells may arise from remains of the omphalomesenteric duct (*umbilical cysts, omphalomesenteric cysts*).

The origin of entodermal and mesodermal cysts can usually be determined from the anatomical relations and their structure. When the misplacement of the tissue is but slight, and when the anatomical structure still shows clearly the character of the mother tissue the genesis of the growth may be easily determined. The size of these cysts varies from that of a pinhead to that of a man's head. Their clinical importance is dependent upon their location, size, and the character of the secondary changes occurring in them. The cyst wall may become inflamed or undergo degeneration, or through an active epithelial proliferation either adenoma or carcinoma may develop. Adenomata, cystadenomata, and adenomyomata develop frequently from remains of the Wolffian body. In rare cases an adenoma may develop from the remains of the omphalomesenteric duct (*umbilical adenoma*). Adenomata and cylindrical-celled carcinomata may develop from snared-off portions of intestine, or of kidney and liver tubules.

3. Complex Teratoid Cysts and Tumors.—The teratoid cysts and tumors of complicated structure are found in the same regions as the simple teratoid growths, but occur most frequently in the sexual glands, and in the region of the coccyx. Their complicated structure is shown by the presence, either in the cyst wall or in the solid growth, of a great variety of tissues: squamous and columnar epithelium, ciliated epithelium, dermal structures, nerve tissues, cartilage, bone, striped and unstriped muscle, fat tissues, gland tissues, etc. They may also contain tissue of a carcinomatous or sarcomatous nature. The different tissue elements are sometimes of embryonal character. At other times they resemble fully matured tissue. They are sometimes found in orderly arrangement, suggesting the arrangement of tissues and organs found in the normal human body. In many cases, however, there is no definite grouping of tissue elements beyond that of the germ layers, ectodermal tissues being grouped together, mesodermal together, etc. The cysts may be lined with squamous, simple columnar, or ciliated epithelium, and in the first case may contain hair. Teeth and bone are of frequent occurrence in these growths.

Complicated tumors belonging to this class occur in the mouth, nose, and throat, as the so-called *hairy polypi*, consisting of polypoid growths covered with hairy skin, and a mass of adipose tissue in which cartilage, bone, teeth, muscle, gland tissue, cysts, etc., are found. In the kidney they occur as solid tumors consisting of sarcomatous tissue containing tubular glands, striped and unstriped muscle, cartilage, bone, etc. Similar tumors are found in the vagina and cervix of young children; they consist chiefly of myxomatous and fibrous tissue, striped and unstriped muscle, and more rarely cartilage and gland tissue. Tumors containing cartilage, bone,