

muscle, glands, nerve tissue, fibrous, myxomatous, and adipose tissues, ectodermal and endodermal cysts, etc., are found in the region of the coccyx, in the cranium, orbit, mediastinum, abdomen, neck, and lumbo-sacral region. The tissue elements forming these growths may be grouped into rudimentary or fully developed body parts, so that it is possible to recognize portions of the respiratory or intestinal tracts, etc. The complex teratomata of the ovary and testis form the most important and interesting tumors of this class. They occur partly as solid tumors containing multiple cysts, and partly as dermoid cysts, the former being found chiefly in the testis, the latter in the ovary.

Ovarian Dermoids.—The complex dermoids of the ovary occur usually in the form of thick-walled cysts, varying in size from that of a pea to that of a man's head, or even much larger, and containing a fatty pul-taceous material, and hair of a light or reddish color. Extending into the cavity of the cyst at some point in its wall there will always be found a polypoid, flat, nodular, or septum-like prominence covered with hairs, and often set with teeth. The latter may arise from a bony formation suggesting the jaw bone. The inner lining of the cyst consists of columnar epithelium, while that of the prominence extending into the cyst consists of skin structures, epidermis, dermis with papilla, hairs, sweat and sebaceous glands, and beneath these subcutaneous fat. The cyst contents consist of desquamated horny cells undergoing disintegration, cholesterol plates, and hairs. Occasionally the contents are serous or mucoid. The columnar cells lining the remainder of the cyst wall may be absent in part; and the surface so denuded may be covered with granulation tissue, containing many giant cells, which in part surround hairs that have been implanted secondarily into the bare surface. The deeper layers of the wall and of the prominence in particular contain a great variety of tissues, brain, muscle, cartilage, bone, teeth, glands, spaces lined with ciliated columnar epithelium, thyroid tissue, etc. Representatives of all three germ layers are present, the derivatives of the ectoderm and mesoderm being developed to the greatest extent; in particular the skin and its appendages, bone, teeth, and brain substance; while endodermal structures, such as mucous glands, cysts lined with columnar epithelium, etc., are usually developed to a much less degree, and are found only in the deeper portions of the growth. While all ovarian dermoid cysts possess in general the same essential characteristics, the deviations in the character, amount, and relations of the tissues forming the growth are so great that each tumor may be said to have an individuality of its own. This is very clearly shown in the descriptions given of the various cases of ovarian dermoids reported in the literature. They are not to be regarded as simple tumors or cysts, but are composed of two distinct portions—a purely cystic growth and a tumor composed of embryonal elements, any one of which may develop in excess of the others.

In the simplest forms the cyst enclosing the dermoid is of the monolocular variety, although remains of the septa of a previously multilocular cyst may usually be found on close examination. The cystadenoma may predominate over the dermoid, the latter playing such an unimportant part in the development of the tumor in many cases as to constitute only an accidental finding. In the case of a multilocular cyst the dermoid may be located upon the wall of the chief cyst, or upon a septum in the midst of the cystadenoma. Usually, however, the dermoid structures stand out from the wall as a hairy prominence, as described above.

The dermoid portions of the growth may be localized to that part of the cyst wall which is occupied by the prominence, or they may be scattered throughout the wall. In addition to the simple tissue elements various rudimentary organs and structures have been described as occurring in these growths. The parts of the body most frequently found are those of the cephalic end; hence the frequent occurrence in these tumors of brain tissue, max-

illary bones, teeth, rudimentary eyes, oral structures, etc. Sections through the dermoid area usually show a groundwork of adipose tissue, through which run connective-tissue trabeculae containing bone or cartilage. The areas composed of brain tissue may often be recognized by the naked eye. Portions of the skeleton, and such structures as the mammary gland, mouth, eye, etc., may also be recognized by the gross appearances.

In a case reported by Regnier an entire skeleton was found, the right extremities showing complete jointing. Axel-Key describes an ovarian dermoid, in which there were found a head with rudimentary jaws, two lower extremities, and an ossified cranium containing brain substance. In a case observed by Wertheim two extremities were attached to the top of a dermoid containing a well-developed jaw. Graves reports a case in which there was found a head-like extremity with orbital sockets and eyelids with lashes. In a dermoid removed by Thornton there was a head-like process with maxilla containing teeth, and the stump of an extremity tipped with long nails. Klausner reported a case containing an entire extremity with jointed skeletal attachment, and fingers with rudimentary nails; Wilms, a case containing an upper jaw with well-formed molar and premolar teeth and a petrous bone; Grechen, one with an entire lateral wall of the cranium; Schramm, a case showing an ossified rib; Küster and Smigrodsky have reported the presence of pelvic bones and ribs; Kapeller, several jointed bones; Pfannenstiel two bones joined by a ball-and-socket joint; and a number of observers have reported the presence of fingers. In some cases the upper and lower jaws have been so well formed as closely to resemble normal specimens; but usually they are so irregular that such a differentiation is impossible.

Teeth are found in the majority of these growths. In some cases several hundred are present. They are sometimes situated within a rudimentary oral cavity, and may project from the alveolar border. Not infrequently they are enclosed within the bone. The dental structure is normal, and all the varieties of teeth may be found; incisors, molars, etc., being arranged upon a rudimentary jaw bone. The absorption of milk teeth and the formation of permanent teeth have also been observed. Such a secondary growth may explain the large number of teeth seen in some cases. Besides the teeth, other structures belonging to the mouth region are seen. Simons has described a parotid gland, Fleischlen a submaxillary, and Mortens and Kroemer have found muscle beneath a mucous membrane, the structure suggesting a rudimentary tongue. In those cases in which there is a more or less well-defined oral cavity there is a sharp line of transition between the epidermis and the oral mucosa. A narrow tube running from the oral cavity in one case was regarded as a rudimentary oesophagus. Thyroid tissue has been found in a number of cases.

Brain tissue may be present in very large amounts. In some cases cerebral hemispheres, gyri, cerebral fissures, and pia mater have been seen. All stages from the earliest rudiments to the fully-developed type are seen. The brain is usually enclosed in a fibrous envelope consisting of a single or several layers of connective tissue. The outer layers contain a great deal of elastic tissue, and often cartilaginous and osseous areas. In some cases it is possible to differentiate between the dura and the pia. In the majority of cases the most striking evidence of the presence of rudiments of the brain is afforded by the retinal pigment, which is of very common occurrence in these tumors. In a number of cases more or less completely developed optical vesicles have been found in the shape of bilateral pedunculated appendages. Born has described open spaces and bony structures lying posterior to the optical vesicle, and he considers them to be the rudiments of the ear. The brain tissue is sometimes differentiated into cortical and medullary layers, the former containing typical pyramidal cells. In some cases cranial nerves and ganglia were found which were regarded as corresponding to the optic and trigeminus. Sympathetic ganglia are frequently present. Kroemer observed

a sympathetic plexus within the muscular wall of a rudimentary intestine. In a case reported by Kappeler a complete medullary tube with central canal, anterior commissure, longitudinal sinus, and intervertebral ganglia enclosed in a vertebra were found.

The presence of mammary gland tissue has been noted by several observers. Of these cases the most remarkable is the one described by Yamagiva, who regarded the adenocarcinomatous changes found in a teratoma of the ovary as primary in a nipple-like growth of mammary gland tissue which presented itself on the inner surface of a large dermoid cyst.

Of endodermal tissues, there have been found rudimentary oesophagus, trachea, larynx, lungs, nasal and pharyngeal cavities. In all of these an abundance of ciliated epithelium was present. Portions of the gastrointestinal tract lined with cylindrical epithelium containing goblet cells have also been observed. Typical villi, intestinal glands, a characteristic muscular wall, typical Peyer's patches, and solitary follicles were present. In one case described by Pommer there was a caecum-like intestine with a vermiform appendix. Liver and pancreatic tissues have not yet been observed.

Of mesodermal tissues, there have been observed the various connective tissues, cartilage, bone, marrow, striped and unstriped muscle, lymph glands, lymph- and blood-vessels. Kroemer found a rudimentary uterus, in which the branching glands of the cervix and the tubular fundal glands were easily differentiated. Katsurada has recently reported the presence of heart muscle. Kidney tissue has not yet been observed.

Solid Teratomata of the Ovary.—The solid mixed tumors of the ovary are somewhat more rare than the dermoid cysts. They contain the same tissues found in the latter, but differ from these in that the tissues show a less orderly arrangement, and, as a rule, a more rudimentary character. They may contain numerous small dermoid cysts. Inasmuch as transition stages may be found between the dermoids and the solid teratomata, the two forms are to be classed together as closely related genetically. In some cases the solid character of the growth may be due to adenomatous, carcinomatous, or sarcomatous proliferation of the tissues of a dermoid. There is, however, no very logical reason for separating the so-called dermoid from the solid form.

The ovary may be completely destroyed by these tumors, but in the majority of cases some remains of its tissues are preserved. The dermoids and solid teratomata of the ovary are observed most frequently in early adult life, but may occur in children. They not infrequently develop at puberty. Several dermoids may in very rare cases be found in the same ovary. They occur on both sides in about fifteen per cent. of the cases. Carcinoma or sarcoma may develop in these growths, and secondary inflammation, degeneration, etc., may also take place.

Since the most characteristic feature of ovarian dermoids and solid teratomata is the fact that they contain tissues derived from all three of the germ layers, their structure gives the impression of a rudimentary embryo, and they have been accordingly classed as *embryomata*. By some writers the term *embryoma* is applied only to the dermoids, while the solid teratomata, because of their lack of any structural organization approaching that of the human embryo, are designated *embryoid tumors*. The presence of tissues derived from all three of the germ layers can be explained only by the assumption of a development from an ovum. According to Wilms and others, a *parthenogenetic development of an unfertilized ovum* may be assumed. No absolute proof of this hypothesis exists at present, and nothing is known concerning parthenogenesis in mammalian ova. It does not seem probable that the development of these tumors is due to parthenogenesis, since the latter is a normal process in lower animals and plants, having for its aim the propagation of the species, and the development of these tumors can be regarded only as a pathological process, in which the growth and differentiation of tissues and organs

are atypical and apparently without a definite law. In favor of the ovulogenous theory of origin is an observation made by Lee in one case in which the minute dermoid maintained the same relationship to the follicular cavity as that of the ovum to the follicle. Steinlin has also described a case in which a small dermoid remained as an intrafollicular growth connected with the follicle wall by a delicate vascularized pedicle. Sutton made a similar observation in the case of a dermoid cyst in the ovary of a horse, and Kroemer was also able to establish a similar relationship between the dermoid and the follicle in two cases in the human being. From these observations it would appear that the epidermal covering of the dermoid is derived from the ectoderm of the ovum. The dermoid is sometimes surrounded by a membrane resembling amnion.

Bonnet, on the other hand, regards it as much more probable that the complex ovarian teratomata arise from *one or more blastomeres which during the early stages of development of a fertilized ovum* are delayed in division, and later give rise to an independent formation containing elements of all three germ layers; or that a *fertilized polar body* finds its way between the blastomeres of a developing ovum, and later develops within the embryo. The fertilization of the polar body has been demonstrated in vertebrates. The first assumption seems more probable, and the ovarian embryomata and embryoid tumors may, therefore, be regarded as *rudimentary unioval twin malformations*, and are to be placed in the same category with the fetal inclusions found in other organs. The fact that the ovary is the favorite seat of such growths may be dependent upon the fact that the urogenital anlage forms relatively such a large part of the embryonal anlage, or that the blastomeres from which the sexual glands arise take on more easily than others an especial development which leads to the formation of a rudimentary twin. Duplication of the embryonic area, or of the primitive streak or medullary groove, with subsequent inclusion of one twin (parasite) by the autosome might explain the formation of some of the ovarian embryomata. Wilms, Pfannenstiel, and Kroemer are the chief advocates of the ovulogenous origin of these tumors. Bandler, on the other hand, has recently attempted to prove their congenital origin, holding that they arise from derivatives of the ectoderm, which have a mesodermal stroma, viz., the Wolffian bodies and ducts (according to Spee, the epithelium of the Wolffian body and duct comes from the ectoderm). Bandler, therefore, holds that the ovarian dermoids and cystadenomata have a closely related histogenesis. His attempt to refer the embryomata of the sexual glands to ectodermal implantations occurring accidentally during the development of the urogenital system cannot be regarded as successful, since the anlage of many structures found in these tumors (teeth, thyroid, eye, etc.) cannot possibly be located in the urogenital anlage. There is an increasing number of writers who accept the ovulogenous origin, but the majority of these reject the hypothesis of parthenogenesis. The etiology of the anomalous development of the ovum is not yet known.

Complex Teratomata of the Testicle.—Complex tumors of the character of the ovarian dermoids have been found in the testicles, in the case of both children and adults, but are of rare occurrence. Their structure is essentially the same as that of the ovarian tumors. Solid complex teratomata are of much more common occurrence in the testicles. They may be congenital, but are found more frequently in early adult life. In structure they differ from the complex ovarian teratomata in that they do not contain so great a variety of tissues, and that these are not grouped so as to form easily recognized organs or systems. The tissue elements, moreover, are more embryonal in character and attain only a very rudimentary development. Ectodermal tissue is present usually in but scanty amounts, and is represented by pigmented epithelium or by small groups of cells showing cornification. In some tumors it may be entirely absent, or at least cannot be demonstrated. The cysts are lined usu-

ally by entodermal epithelium, but the character of the epithelium may vary in one and the same cyst. Simple cubical and cylindrical epithelium, either with or without cilia, stratified cylindrical ciliated epithelium and pigmented epithelium may be found. Mucous glands may also be present. Of the connective-tissue elements, fibrous tissue, myxomatous tissue, cartilage, bone, striped and unstriped muscle, are most frequently present. All these present a more cellular and embryonal character than the tissues found in the ovarian teratomata. As a rule, some one of the tissues predominates, and a carcinomatous or sarcomatous proliferation occurs in the majority; hence the teratomata of the testis have been reported under a great variety of names: *adenochondroma*, *adenocystoma*, *chondrosarcoma*, *malignant chondroma*, *rhabdomyosarcoma*, *adenomyosarcoma*, *cystosarcoma*, *cystocarcinoma*, *adenocarcinoma*, *myxosarcoma*, etc. In some cases an endothelial or perithelial proliferation predominates, and the tumor assumes the character of an *endothelioma* or a *perithelioma*. Syncytial-like formations have also been described as occurring in these growths. In some cases the formation of cysts with fluid or mucoid contents is the most striking feature of the tumor; in other cases the growth may be cystic only in part, while in other cases it is solid throughout. They are often of very rapid growth, and those in which carcinomatous or sarcomatous proliferation occurs are of very malignant character, giving rise to numerous metastases throughout the peritoneum, retroperitoneal glands, lungs, etc. The metastasis in the majority of cases is hematogenous, like that of sarcoma. To what extent the teratomata of the testicle are to be classed with the embryomata as of ovulogenous origin, or to what extent they are due to tissue-implantations, cannot at present be determined. Those containing tissues derived from all three of the germ layers may be classed with the embryomata or embryoid tumors; those consisting of single tissue-formations may be explained by the assumption of a tissue-transplantation or inclusion.

The complex teratoid cysts and solid teratomata of other regions, as well as those of the sexual glands, are in many instances to be regarded as local disturbances of development, due to a misplacement or separation by constriction of tissue anlage or tissue within a single individual (*monogerminal tissue-implantation*, *autochthonous teratoma*). The hairy polypi of the throat and mouth cavity, the cystic or solid teratomata at the base of the skull or in the hypophysis may be explained as due to inclusions of ectoderm. The presence of cartilage and mucous glands in the mediastinal teratomata may be explained by the proximity of the trachea. The teratoid mixed tumors of the cervix and vagina are probably due to inclusions of the myotome or sclerotome, and to malformations in the development of the Wolffian duct; those of the kidney are due to proliferation of remains of the Wolffian body, and to inclusions of the myotome; those of the lumbo-sacral and coccygeal regions are due to proliferations of remains of the neuro-enteric canal, hind-gut, and medullary canal, in association with ectodermal and mesodermal inclusions.

There is, however, another possibility of origin for these tumors—they may arise from a rudimentary twin (bigeminal implantation). Such an explanation receives support when the teratoma in question contains fully developed or rudimentary organs or body parts, or tissue-formations that cannot be explained by the misplacement of tissue of a single fetus. The complex teratomata at the base of the skull, in the sacral region, in the mediastinum, and in the abdominal region are regarded by the majority of investigators as bigeminal implantations. Such teratoid tumors are then to be interpreted as parasitic twin malformations, and are to be classed with the double monsters (see *Teratology*). All possible transition forms exist between those composed of rudimentary tissue-elements and the double monsters with symmetrically developed twins. In those cases in which partly or fully developed extremities or organs lie within the tumor mass or cyst the diagnosis of

bigeminal inclusion is clear, but in the case of a more rudimentary development of tissues which are not arranged in an orderly manner it is not always possible to differentiate between monogerminal and bigeminal inclusions.

Malignant Teratoma (*Teratoma malignum*).—Malignant changes may take place in any form of teratoid tumor or cyst, the simple forms as well as the more complex, but are of more common occurrence in the latter. Of the simple teratomata the epidermoids and dermoids most frequently take on a malignant activity of growth (*branchiogenic* and *subcutaneous carcinoma*), although ectodermal inclusions in any part of the body may be the starting-point for an epitheliomatous growth. The tumors of the kidney, vagina, and cervix that contain striped muscle and myxomatous tissue usually behave as sarcomata. The mixed tumors of the salivary and lachrymal glands become malignant much more rarely. Since the great majority of other forms of teratoid tumors are usually benign, the term malignant teratoma is more appropriately applied to the malignant embryomata and embryoid tumors. The complex dermoids are less frequently malignant, or at least but relatively few cases of carcinomatous or sarcomatous dermoid of the ovary have been reported. Yamagiva has reported a unique case of a dermoid of the ovary, showing adenocarcinomatous changes. The patient was a woman sixty-three years old, dying from the effects of a large ovarian tumor, which was in part composed of solid mixed tissues and cysts, and partly dermoid. The adenocarcinomatous changes present he regarded as primary in a mammary gland which presented itself on the inner surface of the large dermoid cyst. Metastases were present in the retroperitoneal, mesenteric, and right supraclavicular glands. To Bierman belongs the credit of having recorded the first case of epidermal cancer arising from the epidermal lining of the cyst cavity. Similar cases have been reported by Krukenberg, Clark, and others. The majority of the cases have been in women at or near the menopause. The metastases are found chiefly upon the peritoneum. Of much greater frequency is the development of carcinoma or sarcomatous changes in the solid complex teratomata of the ovary, testis, and mediastinum. In the case of the malignant teratomata of the testis the metastases may present the appearances of cystocarcinoma, cystosarcoma, chondrosarcoma, chondrocarcinoma, myosarcoma, myxosarcoma, endothelioma, etc. Occasionally the metastases show differences of structure, or may present a combination of tissue elements. This may be explained by the metastasis of undifferentiated cells. In some cases the tumor presents the appearance of a mixture of sarcomatous and carcinomatous proliferation (*"sarco-carcinoma"*). The distribution of the metastases varies somewhat with the character of the malignant changes. In the case of adeno- or cystocarcinoma of either an ovarian or a testicular teratoma the metastases are found chiefly upon the peritoneum; in other cases the metastases are usually hematogenous, and are found chiefly in the lungs.

TREATMENT.—The fact that a large class of tumors is composed of tissue-formations resembling those of the normal body, and derived from misplaced anlage or tissue, or from foetal inclusions, throws important light upon the treatment. Since such tumors are manifestly not of parasitic origin, their treatment by toxins, antitoxins, Roentgen rays, etc., is naturally contraindicated. Only those toxins would destroy the mixed tumors which would at the same time destroy the normal tissues. The treatment is purely operative, and even here the knowledge of the mixed nature of the tumor is of great importance in modifying the operation. The mixed tumors of the mamma do not set up metastases in the axillary glands; and since the encapsulated mixed tumors in general usually give rise to hematogenous metastases, and not lymphogenous, a more conservative operation may be carried out than in the case of carcinoma. In the case of the tumors of the testis the greater tendency to malignancy with the rapid setting up of

metastases in the peritoneum in the case of carcinomatous change, and in the lungs in the case of sarcomatous or endotheliomatous changes, speak for the necessity of early operation. (See also *Teratology*, *Hypernephroma*, etc.)
Aldred Scott Warthin.

TEREBENE.—Terebene, $C_{10}H_{16}$, is a liquid hydrocarbon, obtainable by the action of strong sulphuric acid on oil of turpentine. It is a colorless, mobile fluid, of a pleasant pine-wood odor and taste, free from the acidity of oil of turpentine. It is insoluble in water, but dissolves in an equal measure of alcohol.

Under the name *Terebenum*, Terebene, the United States Pharmacopoeia makes official "a liquid consisting chiefly of pinene, and containing not more than very small proportions of terpinene and dipentene." Terebene should be kept in well-stoppered bottles and in a cool dark place.

Terebene seems to affect the human system like a mild oil of turpentine. It has been taken in so large quantities as a teaspoonful every four hours, continued for a week, without untoward effects; but such quantities are unsafe. Under the influence of the medicine the urine acquires an odor as of violets, and may increase slightly in quantity. Medicinally, terebene has been found of service for the alleviation of cough and dyspnoea from respiratory disease, and of dyspepsia with flatulence and acidity. The drug is commonly given in doses of ten drops, or thereabouts, in emulsion or in capsules. It is not at all unpleasant to take, clear, washed down with a small sip of water. In respiratory affections the vapor of terebene may be inhaled in addition to the internal administration.
Edward Curtis.

TERPIN HYDRATE.—When a mixture of turpentine oil and water is permitted to stand, crystals of terpin hydrate, $C_{10}H_{18}(OH)_2 + OH_2$, often deposit. For artificial preparation of the crystals in quantity, a mixture is made of oil of turpentine, nitric acid, and alcohol, which is set aside in shallow vessels for crystallization to occur. The substance is official in the United States Pharmacopoeia under the title *Terpini Hydras*, Terpin Hydrate. Terpin hydrate is in the form of colorless, rhombic crystals, practically devoid of odor and taste. It dissolves in about 250 parts of cold water and in 32 parts of boiling water; in 10 parts of cold alcohol and in 2 parts of boiling alcohol. The drug is claimed to possess the medicinal "expectorant" virtues of the terebinthines, while free from the deranging influence of the class. It may be administered in doses ranging from 0.20 gm. to 0.65 gm. (from gr. iij. to x.), given a number of times daily, in emulsion or pill.
Edward Curtis.

TERPINOL is an oily liquid of hyacinthine taste, obtained by distilling terpin hydrate with dilute sulphuric acid. It consists of *terpinol*, $C_{10}H_{17}OH$, mixed with three terpenes, $C_{10}H_{16}$, and is insoluble in water and soluble in alcohol and ether. Lazarus employs it like terpin hydrate as a bronchial stimulant and antiseptic in dose of 0.3 c.c. (m. v.). Janowsky gives it in hæmoptysis, three drops frequently repeated. It is sometimes added to iodoform as a deodorizer. Under the name of "stomatol," a mixture of terpinol, soap, alcohol, and aromatics, is sold as a mouth wash and general antiseptic and deodorizer.
W. A. Bastedo.

TESTICLES, DISEASES OF. See *Sexual Organs, Male, Diseases of.*

TETANUS.—(Synonyms: Trismus, Lockjaw.) Tetanus is an acute infectious disease caused by inoculation with the tetanus bacillus, and characterized by tonic spasm of certain muscles, sometimes by clonic spasms as well. The more severe acute cases usually end fatally in from one to seven days. Mild cases, sometimes called chronic, may last for some weeks and end in recovery.

For a full description of the tetanus bacillus the reader is referred to the article on *Bacteria*, p. 698, vol. 1., of

this HANDBOOK. It must be remembered that this organism is almost everywhere to be found in garden and field soil, in the street dirt of cities, about manure piles, and in the foul mud of marshes and river beds. The reason that more people are not infected by this well-nigh omnipresent germ is because it is anaerobic and quickly killed by sunlight.

ETIOLOGY.—For the growth of the tetanus bacillus in or upon the human body it is essential that there be a wound upon which the bacillus shall be received. If the wound be septic or becomes septic, it offers the best soil for the growth of this bacillus, since the ordinary septic organisms absorb all the oxygen present and so produce the anaerobic conditions necessary for the life of the tetanus bacillus. It is doubtful whether any truly aseptic wound was ever the seat of tetanus infection. There need, however, be no gross solution of continuity in order for the development of the tetanus bacillus, since it has been found at the site of a severe blow or bruise.

PATHOLOGY.—There are no definite anatomical changes as yet known to belong to this disease. The bacillus is to be found in or near the infected wound, although the local lesion may not be prominent and the wound may have healed. A few observations are on record in which the bacilli were found on the *placenta* and arachnoid of the spinal cord. In the brain and cord are found perivascular exudation, congestion, and granular degeneration of nerve cells. The local infection with the tetanus bacillus seems to produce a toxin, which, when it reaches the brain and spinal cord, causes symptoms similar to those of strychnine poisoning. A substance called tetanin has been isolated from tetanus cultures; it is said to be four hundred times more poisonous than strychnine.

SYMPTOMS.—The period of incubation varies considerably. In temperate climates it is likely to be two weeks, sometimes three. In tropical climates, or in localities where the disease is especially virulent, there may be as short a period as one day. The onset is gradual, with soreness and stiffness in the muscles of the neck and jaw, until at the end of from one to three days the mouth cannot be opened (trismus or lockjaw). This muscular rigidity or tonic spasm extends to the muscles of the face and trunk, in less degree to those of the legs, while the arms are often exempt. The contraction of the face muscles so draws up the corners of the mouth as to produce a fixed grin, the so-called *risus sardonius*. The abdominal and chest muscles become board-like in their rigidity, greatly impeding respiration. The body is often arched backward (opisthotonos), or it may be fixed in some other position. An aggravation of the spasms, which may have somewhat relaxed, is produced by any sudden stimulant, such as a loud noise, a draught of cold air, or an attempted movement. These spasms are always tonic or continuous, never intermittent. Some patients complain of great pain connected with the spasms, others of none whatever. The mind usually remains clear throughout. The temperature in mild cases may be but little raised. Usually, however, it reaches 104° or 105° F., sometimes as much as 108° during life, and it often rises a degree or two after death. The body is bathed in sweat, the urine is scanty and often albuminous. Death may occur in twenty-four hours from the outbreak of the disease, or not for four or five days.

Chronic tetanus usually begins a longer time after infection, is milder in form, often without fever, and the spasmodic contractions may be limited to the part of the body near the wound, although they may also be general. This form may last for two or three weeks and is much less fatal. A variety of the chronic form, called by the Germans *Kopf-tetanus*, follows injuries about the distribution of the cranial nerves, especially those of the supra-orbital margin. It is marked by trismus with facial paralysis, although both tonic and clonic spasms may occur in other parts of the body.

DIAGNOSIS.—The history of a poisoned wound, especially a dirty, punctured wound of the foot or hand, is an important factor in the diagnosis. Mild forms of tris-